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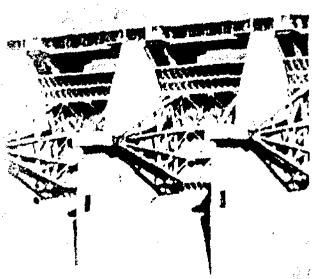

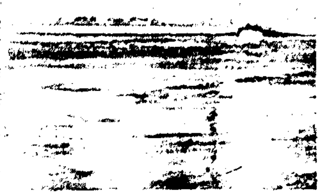

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WATER QUALITY STUDIES IN THE UPPER YAZOO PROJECT AREA, MISSISSIPPI

by

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13. ABSTRACT *(Maximum 200 words)*

Potential effects of flood control structures on water quality in the Upper Yazoo Project (UYP) area is of concern to the US Army Engineer District, Vicksburg, and to other Federal and state agencies. This study was designed to provide information in the following five subject areas: general water quality in the Yazoo River, general water quality in Bear Creek, effects of channelization in a selected reach of the Yazoo River, pesticide contamination in sediments of the UYP area, and baseline data on water quality in selected oxbow lakes. Emphasis was placed on comparing historical water quality data with current data to define general trends since the 1970s. Results indicated that general water quality in most study areas has improved.

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PREFACE

This report was prepared by the Environmental Laboratory (EL) of the US Army Engineer Waterways Experiment Station (WES), Vicksburg, MS, for the US Army Engineer District, Vicksburg, Vicksburg, MS. Personnel who cooperated in the execution of the study and the preparation of this report include Dr. Judith C. Pennington (Project Coordinator), of the Aquatic Processes and Effects Group (APEG); Mr. Dennis L. Brandon of the Contaminant Mobility and Regulatory Criteria Group (CMRCG); Drs. Carlos E. Ruiz and Barry W. Bunch of the Water Quality Modeling Group (WQMG); and Mr. Steven L. Ashby, Mr. Thomas C. Sturgis, Mrs. Cynthia B. Price, and Dr. James M. Brannon of the APEG. Project manager at the Vicksburg District was Mr. Dave Johnson.

Collection of water samples, field analyses, and chemical analyses for routine water quality parameters were conducted by the US Department of the Interior Geological Survey, Water Resources Division, Jackson, MS. Mr. Larry J. Slack coordinated the effort. Chemical analyses of water, soil, and sediment samples were provided by the Analytical Laboratory Group, EL, under the direction of Ms. Ann B. Strong.

The report was prepared under the general supervision of Dr. Thomas L. Hart, former Chief, APEG, and Dr. Richard E. Price, Acting Chief, APEG; Dr. Lloyd H. Saunders, Chief, CMRCG; Dr. Mark S. Dortch, Chief, WQMG; Mr. Donald L. Robey, Chief, Ecosystem Research and Simulation Division; and Dr. John Harrison, Chief, EL.

COL Larry B. Fulton, EN, was Commander and Director of WES. Dr. Robert W. Whalin was Technical Director.

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CONVERSION FACTORS, NON-SI TO SI UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
acres	4,046.873	square meters
feet	0.3048	meters
miles (US statute)	1.609347	kilometers
tons (2,000 pounds, mass)	907.1847	kilograms

WATER QUALITY STUDIES IN THE UPPER YAZCO PROJECT AREA, MISSISSIPPI

PART I: INTRODUCTION

Background

The Upper Yazoo Project (UYP) area is characterized by a hill region in the east and a flat delta region of extensive agriculture in the west. Erosion resulting from flooding has been a problem in the area with an estimated loss of millions of tons of soil per year carried by the Yazoo River and its tributaries. Conversion of bottomland hardwood forests into agricultural lands has also generated concern for enhanced loss of soils through loss of catchment basins. Results of previous studies conducted during the 1970s also indicated pesticide* contamination in some areas.

Concern for the potential environmental impacts of US Army Engineer District, Vicksburg, flood control measures in the UYP area have been expressed by state and Federal agencies. For example, Region IV of the US Environmental Protection Agency (EPA), in a review of the "Upper Yazoo Basin Fish and Wildlife Mitigation Study for Fish and Wildlife Losses in the Ascalmore Creek-Tippo Bayou Project, Big Sand Creek Projects and Panola-Quitman Floodway East Bank Levee Project, Implementation, MS," strongly suggested that water quality concerns be addressed in proposed mitigations for the project (EPA 1989). To address these concerns, the District has initiated a restudy of water quality in the area.

Water quality in the UYP area is greatly influenced by intensive agricultural activities. Of special interest are changes in land use and flood control structures that may impact pesticides and sedimentation resulting in reduction in water quality. The broad objective of this report is to assess water quality within the basin so that an evaluation of potential impacts of CE activities for flood control in the project area can be made by Vicksburg District personnel.

The extensive size of the UYP precluded comprehensive sampling for water quality characterization throughout the area. Therefore, a smaller subwatershed, Bear Creek, which is representative of the heavy agricultural areas, was

* The term *pesticide* as used in this report refers to insecticides and herbicides collectively.

selected for periodic sampling. The Bear Creek watershed consists of a group of small streams linking a series of lakes. The watershed is characterized primarily by agriculture and bottomland hardwood forests. Eleven stations in the Bear Creek watershed were sampled four times, corresponding to applications of agricultural chemicals. Three additional stations established in the UYP, but outside of the Bear Creek watershed, were sampled twice. Locations were selected for which historical water quality data were available.

Dredging and channel maintenance is a major part of flood control efforts in the UYP. To determine the potential effects of dragline channelization on water quality, a small comparative study was conducted in a channelized and unchannelized reach of the Yazoo River.

Analysis of sediment samples provides insight into sources and sinks of pesticides and other environmental contaminants. Analysis of sediment cores can also provide a record of the history of contaminant concentrations as sedimentation has proceeded. Therefore, surficial sediments were sampled extensively in the UYP, including the Bear Creek subwatershed, and in the areas of the channelization comparative study. Cores samples were also collected at selected sites throughout the UYP.

Concern for general water quality and the presence of organochlorine insecticides in oxbow lakes motivated a one-time sampling event to obtain baseline water quality in Alligator Bayou/Sidon, Bee, Roebuck and Wolf Lakes. One sediment core was also collected in each of the four oxbow lakes.

To determine whether confined dredged material disposal facilities (CDFs) serve as sources or sinks for contaminants, pesticide concentrations in sediment cores from several representative CDFs were compared with concentrations from cores collected in adjacent fields.

Objectives

Objectives of the study were as follows:

1. To characterize general water quality in the Yazoo River.
2. To characterize general water quality in the Bear Creek.
3. To compare water and sediment quality in a channelized versus an unchannelized area.
4. To describe historical trends in contaminant concentrations using historical pesticide data and data from sediment cores.
5. To determine baseline water quality in selected oxbow lakes.

PART II: GENERAL WATER QUALITY

Bear Creek

General description

The Bear Creek watershed is located in west-central Mississippi (Figure II-1). The total area of the watershed is 84,280 acres* with the greatest area located in Leflore County (49,610 acres) and the remainder in Humphreys (19,110 acres) and Sunflower (15,560 acres) counties. The watershed is flat and low with elevations varying from 90 to 130 feet. It is bordered on the east by the Roebuck Lake and Yazoo River watersheds. The Quiver River watershed borders Bear Creek on the north as does the Little Sunflower River drainage basin on the west. Bear Creek discharges into the Yazoo River approximately 5 river miles north of Belzoni, MS.

The watershed which is predominantly rural, contains only the community of Swiftown, a portion of the community of Morgan City, and a portion of the town of Itta Bena. Most of the land in the watershed is used for agriculture. There is no heavy industry in the watershed.

Surface water

Bear Creek is actually a group of small creeks which connect a series of lakes beginning with Blue Lake in the north and ending with Wasp Lake in the south (Table II-1). The total length from the upper end of Blue Lake to the lower end of Wasp Lake is slightly greater than 50 miles. Blue Lake is fed by Gayden Brake, a cypress-tupelo-gum swamp with a surface area of 1,625 acres located on the southwestern edge of Itta Bena, MS (Vicksburg District 1980).

Bear Creek begins at the lower end of Blue Lake and flows for 19 miles before emptying into One Mile Lake (Figure II-1). In this region the creek is shallow, slow flowing, and at times stagnant. Brush and large trees are found along the banks and within the creek itself. Creek width in this area varies, but is typically 50 feet or less.

One Mile Lake is the smallest of the lakes fed and drained by Bear Creek and is connected to the upper end of Mossy Lake during periods of high water. Bear Creek continues from the lower end of One Mile Lake for 3 miles before reaching Three Mile Lake. Next to Three Mile Lake is Macon Lake. Macon Lake

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* A table of factors for converting non-SI units of measurement to SI units is presented on page 8.

is connected to Bear Creek when either Macon Lake's or Bear Creek's water level rises above 115 ft. When the water surface is below this elevation, the connecting chute is dry.

Other segments of Bear Creek connect Three Mile Lake to Six Mile Lake, Six Mile Lake to Four Mile Lake, and Four Mile Lake to Wasp Lake. Between Six Mile Lake and Four Mile Lake are the community of Swiftown and the outfall of Beckam Bayou, which drains the area south and east of Swiftown. Wasp Lake discharges into the Yazoo River 5 river miles above Belzoni, MS. Wasp Lake discharge is regulated by a control structure built to prevent backwater flooding by the Yazoo River. Before construction of this structure, the lower lakes of the Bear Creek watershed (Three Mile, Four Mile, Six Mile, Wasp), as well as Sky Lake, were periodically flooded by backwaters from the Yazoo River (USDA 1981).

Several other bodies of water occur in the Bear Creek watershed. Among the largest are Sky, Mossy, Little Mossy, Macon, and McCoy Lakes. Numerous swamps and marshes are scattered throughout the basin. Many are contiguous to Bear Creek or its lakes. This watershed also contains many manmade catfish ponds, most of which were constructed in the past decade.

Forests and wetlands

The original forest cover of the Bear Creek watershed was cleared long ago for farming. Visual inspection of land-use maps from the late 1970s (Vicksburg District 1980) and satellite imagery from 1988 indicates only a slight decrease in the acreage of woodland (approximately 125 acres). Currently, 14,790 acres of woodlands, the vast majority of which are also wetlands, occur in the basin. Most woodlands are congruent to Bear Creek or its lakes. These woodlands are best described as bottom-land hardwood (BLH) forests. Trees commonly found in the watershed include cypress, tupelo gum, cottonwood, sweetgum, and various oaks.

Agricultural lands

The majority of the watershed is used for farming. The most common crops are cotton and soybeans (Table II-2). Visual comparison of land-use maps generated from satellite imagery taken in 1988 to those of an earlier study on the Yazoo Basin (Vicksburg District 1980) indicates that the total amount of agricultural land in the basin is unchanged. However, in the study conducted for the Vicksburg District USACE (Vicksburg District 1980), no distinction was made between the different types of crops grown in the watershed or the amount of agricultural land not in production as part of a Federal Agricultural Crop Reduction (ACR) program.

The greatest change in agriculture in the Bear Creek watershed is the establishment of substantial commercial catfish farming operations. In 1980 only one catfish pond existed in the watershed. It had a surface area of 20 acres. By 1990 over 2,800 acres of ponds had been constructed. These ponds occupy 3.3 percent of the total area of the watershed, the same amount as the total of all other bodies of water in the watershed, including Bear Creek and its lakes. Catfish ponds are located on lands that were once used for conventional agricultural crops. Several thousand additional acres of catfish ponds are located in areas adjacent to the Bear Creek watershed.

Current and Historical Trends in Water Quality

Bear Creek restudy

In January 1990, 11 sites and an alternate were selected in the Bear Creek watershed for water quality studies (Table II-3 and Figure II-1). These sites were the same locations used by the US Department of Agriculture Sedimentation Laboratory in an earlier study on the hydrological, biological, and chemical regimes of the Bear Creek watershed between 1976 and 1979 (USDA 1981). All sampling in the current study was done from bridges at these sites just as it had been in the earlier study. Sampling periods and the rationale for selecting them are listed below.

Sampling Period	Rationale
1. March-April	Spring cultivation, application of pre-emergence herbicides
2. May-June	Planting, application of post-emergence herbicides
3. August	Traditional period of heavy insecticide applications and poor water quality
4. October	After application of cotton defoliates

The August sampling was conducted in the same manner as the other samplings, except that only four stations were sampled for pesticides. All water samples collected in Bear Creek were analyzed for the parameters given in Tables II-4 and II-5 according to the methods given in Appendix A.

Water quality data obtained during this study are contained in Appendix B. In the case of pesticide data, the text includes only instances in which measurable amounts were detected. Data collected during this study were analyzed and compared to those obtained by the USDA during the 1976-79 study (USDA 1976a-b, 1977a-d, 1978a-d, 1979a-d).

The USDA study on the Bear Creek watershed (USDA 1981) was conducted to determine whether dredging of Bear Creek or construction of a control structure across Wasp Lake would decrease flooding in the watershed. Before comparisons between data collected during that study (USDA 1976a-b, 1977a-d, 1978a-d, 1979a-d) and the data collected in 1990 can be made, the effect of the Wasp Lake control structure upon Bear Creek must be considered. First, water levels in the upper portion of Bear Creek (the area above Three Mile Lake) are unaffected by the structure. In the lower portion of Bear Creek (Three Mile Lake to Wasp Lake), the effect of the structure during the time of sampling was not so much an increase in water levels as a change in the source of the water. Water levels on the Wasp Lake side of the structure were close to those on the Yazoo side, but the water on the Wasp Lake side originated in the Bear Creek watershed and was not backwater from the Yazoo River. The same cannot be said for the data collected before construction of this structure.

Staff gauges were not installed in the Bear Creek watershed until after sampling for this study had been completed. Consequently, no stage or flow data were recorded for the upper watershed. In the lower watershed, stages were recorded daily at the Wasp Lake control structure by the Vicksburg District. Observations made during sampling trips for this study indicated flooding of Four Mile, Wasp, and Sky Lakes which inundated fields in the vicinities of Stations 10 and 11 for most of the spring.

Conventional water quality

For the purposes of this report, "conventional water quality" refers to all physical and chemical parameters measured excluding pesticides. Pesticides are covered in a separate section of this report.

Water samples were collected at all stations in Bear Creek for the first sampling on April 17 and 18, the second sampling on June 7, the third sampling on August 29, and the fourth on October 10 and 11. At the same time *in situ* measurements of surface dissolved oxygen, pH, temperature, and conductivity were made. *In situ* measurements are those made within the body of water without withdrawing a sample. Dissolved oxygen, pH, temperature, and conductivity were also measured near the bottom of the larger lakes in the Bear Creek watershed (Blue, Mossy, Macon, Three Mile, Six Mile, Four Mile, and Wasp). These data were compared to data collected previously by USDA (USDA 1976a-b, 1977a-d, 1978a-d, 1979a-d). In the following sections, data for each of the water quality parameters are presented, discussed, and compared with historical data where they are available.

Dissolved oxygen (DO). The DO data obtained during this study were compared with data from the 1976-79 USDA study. Before results of these comparisons are presented, it should be noted that DO concentrations are strongly influenced by weather patterns, especially temperature. Therefore, when comparisons of DO data for a certain period of one year are made to that of the same period in another year, differences may be due to differences in air and water temperatures between the two years. These differences (Figure II-2) are especially pronounced during the spring and fall when significant differences in the temperature (Figure II-3) are common around the same date on different years. Since the first sample of the current study was taken in the first month of spring, its agreement with historical data for the same date from another year is influenced by the similarity of the conditions immediately preceding both samplings (i.e., early spring, late spring, wet winter, rain, etc.).

Both the data obtained in 1990 and those obtained during the 1976-79 USDA study were compared to current State water quality criteria (MDEQ 1990). The criteria stipulate that average daily DO concentrations should not be less than 5 mg/l, and that DO should not fall below 4 mg/l at any time. The numbers of DO samples which fell below 5 mg/l and 4 mg/l for each station during both the current and previous studies are shown in Table II-6.

According to historical data, low DO was more prevalent in the upper reaches (Stations 1-5a) of Bear Creek than in the lower lakes (Stations 8-11). In 1990 one-half of the stations sampled had at least one DO measurement that was below the first State criteria of 5.0 mg/l (Table II-6). The majority of the stations where observed DO concentrations failed to meet State criteria were located in the portion of Bear Creek above Three Mile Lake. At least one DO measurement at Blue Lake (Station 1), and stations on Bear Creek near Pleasant Grove Church (Station 2), near Morgan City (Station 4), and near McCoy Lake (Station 5a), was below 4.0 mg/l. The DO concentrations measured in Bear Creek near Pleasant Grove Church (Station 2) never exceeded 3.3 mg/l. At Stations 2 and 5a, Bear Creek is narrow with trees growing on the banks and within the creek. These factors tend to decrease surface reaeration due to wind effects. Organic matter from the trees which falls into the creek and decays also creates an oxygen demand. In the lower portion of the Bear Creek watershed (Three Mile Lake and below), only Three Mile Lake (Station 8) and Four Mile Lake (Station 10) had DO observations below 5.0 mg/l. In the lower portion of the watershed the lakes are wider, longer, and more open, which allows for greater surface reaeration than in the upper portion of the watershed.

Dissolved oxygen concentrations were measured at various depths below the surface for several stations. These results are presented in Table B2. These data indicated that the DO decreased with depth and that, on several sampling dates, the bottom waters of these lakes had DO concentrations below 1.0 mg/l.

pH. The pH was measured *in situ* at all stations where DO measurements were taken. During the current study, the pH at all stations was within one unit of neutral, which satisfies the current State criterion that pH be between 6 and 8.5. The lowest surface pH observed during the study was 6.05 during the June sampling at Wasp Lake (Station 11). The highest surface pH was 7.76 at Blue Lake (Station 1) on the same date.

Overall, the pH data collected during 1990 agreed well with the data collected during the 1976-79 USDA study. During that study, fluctuations of one pH unit between the biweekly samplings were observed repeatedly, but only a few of those samples would not have met current State criteria. The lowest pH values observed in Bear Creek during the 1976-79 study were 4.6 near New Home Church (Station 3) and 4.75 near Morgan City (Station 4). These were observed during the fourth quarter of 1978 during a period in which water levels at those stations were very low (less than 6 inches).

The pH data from the 1976-79 USDA study indicated that the surface waters in the Bear Creek watershed were slightly acidic. This acidity appears to be caused by the presence of humic acid generated by the decay of naturally occurring organic material. The major source of this organic material is the trees located in and along the upper Bear Creek channel and along the banks of the lakes located in the lower portion of the watershed.

The pH values measured near the bottom of the lakes indicated little change in pH with depth. In most samplings the surface pH differed from the bottom pH by less than 0.2 pH unit (Table B2). The largest pH difference observed during 1990 between the lake surface and bottom (16 ft) was 1.0 pH unit on June 7, 1990 at Blue Lake (Station 1). The surface pH was 7.8 and the bottom pH was 6.8.

Conductivity. Conductivity measurements taken during 1990 exhibited similar behavior to data collected during the 1976-79 USDA study. The values of conductivity measured in 1990 are within the ranges defined by the conductivity measurements of the 1976-79 USDA study. The highest conductivity observed in the Bear Creek watershed in 1990 was 360 μmhos/cm in Bear Creek near McCoy Lake (Station 5a) during the August sampling, and the lowest conductivity observed was 43 μmhos/cm in Macon Lake (Station 7) during April. Conductivities higher than 200 μmhos/cm were measured in Bear Creek near Morgan City (Station 4), in Bear Creek near McCoy Lake (Station 5a), and in Three Mile Lake (Station 8). State criteria for conductivity are based on the effects discharges have upon receiving waters and not just the natural condition of the water. Currently, the addition of substances that would increase conductivity above 1,000 μmhos/cm is prohibited.

In both studies, significant variations in conductivity were observed over a year. At all locations except Macon Lake (Station 7), increases in the conductivity during the late summer and early fall were observed in at least one year of the 1976-79 USDA study. These increases might result in conductivity being three or four times higher than earlier that year. Similar increases were observed during 1990. Only in Bear Creek near Morgan City (Station 4) did the values observed during 1990 greatly exceed those observed during the 1976-79 USDA study. The August and October samplings indicated that the conductivities at this location were 345 and 228 μmhos/cm, respectively. Between 1976 and 1979 the USDA measured conductivities at other stations on Bear Creek of this magnitude and greater on several occasions.

Conductivity measurements taken below the surface indicated that at all stations but Blue Lake (Station 1), conductivity changed little between the surface and the bottom of the lake. The bottom conductivity at Blue Lake was between 1.5 and 2 times the surface conductivity during the April, June, and August samplings (Table B2). The elevated conductivity in Blue Lake below the water surface corresponded to cooler bottom temperatures and anoxic bottom conditions.

Solids. Samples from Bear Creek were analyzed for total solids (TS) and total suspended solids (TSS) (Table II-7). TS concentrations were lowest in Blue Lake and Bear Creek downstream to New Home Church (Station 3) and also in Macon Lake (Station 7). The TS concentrations at these stations remained less than 125 mg/l for all samplings during 1990, with TS concentrations for most samplings being less than 100 mg/l. Higher TS concentrations were observed in

Bear Creek between Morgan City (Station 4) and Three Mile Lake (Station 8). The highest TS concentration observed in Bear Creek was 380 mg/l in April near Old Dominion Plantation (Station 5) (Figure II-4). In this region most of the drainage basin is used for agriculture without green belts between the fields and the creek. The watershed below Three Mile Lake is also used for agriculture, but there is a more substantial green belt between the water and cultivated fields. Green belts allow a portion of the suspended materials in runoff to settle before reaching the creek.

The TSS data indicated that most of the TS in the upper portions of Bear Creek (Stations 1 through 3) were dissolved; that is, they are smaller than the filter pore size used to capture suspended solids (Figure II-4). In the April and June samplings for the section of Bear Creek between Morgan City and Three Mile Lake (Stations 4, 5, 5a, and 8), the fraction of TS due to TSS increased over what it had been for the first three stations. During these dates at these stations, the TSS accounted for between 32 percent (Station 4, April) and 75 percent (Station 5a, April) of the TS. These percentages indicate that increases in the TS are due primarily to increases in the TSS. Since the region between Stations 4 and 8 is agricultural, the increase in suspended solids is probably due to agricultural runoff. During the August and October samplings, TSS accounted for very little of the TS, indicating that the majority of the solids were dissolved. The high percentage of TSS in TS in this reach during the first two samplings suggests that cultivation of agricultural fields was the source of these suspended solids. The TS and TSS data for Six Mile Lake, Four Mile Lake, and Wasp Lake (Stations 9, 10, and 11) also indicated that most of the solids were dissolved. Therefore, much of the TSS load from above Three Mile Lake settles out in the lower lakes of the Bear Creek watershed.

Turbidity. Turbidity values ranged from 175 NTUs (nephelometric turbidity units) at Three Mile Lake (Station 8) in June to 5 NTUs at Mossy Lake (Station 6) in August (Table B1). Turbidity values in Blue Lake (Station 1) and in Bear Creek near Pleasant Grove Church (Station 2) were consistently low for all 1990 samplings. Turbidity was also low in the April and June samplings in Bear Creek at New Home Church (Station 3). This station was dry when the August and October samples were collected. Higher turbidities (45 to 175 NTUs) were observed during the April and June samplings in Bear Creek from near Morgan City (Station 4) to Three Mile Lake (Station 8) and in Mossy Lake (Station 6). At these locations, turbidities less that 10 NTUs were observed during the August sampling. Turbidities at these stations for the October samplings were higher than those of the August sampling, but still less than one-third of the turbidities measured during the first two samplings. The turbidities observed in Six Mile, Four Mile, and Wasp Lake (Stations 9-11) were also highest during the April and June samplings (65 to 130 NTUs), lowest in the August sampling (18 to 25 NTUs), and in between during the October sampling (38 to 70 NTUs). The highest turbidities corresponded to elevated TSS concentrations and the lowest turbidities to low TSS concentrations (Figures B1 to B4). This indicates that TSS is a major cause of turbidity in the Bear Creek watershed.

Chlorophyll *a*. Chlorophyll *a* levels throughout the watershed were generally low for all sampling dates (Table B3), with most sites having concentrations of 0.010 mg/l or less. The highest chlorophyll *a* concentration observed was in August (0.020 mg/l) at Wasp Lake (Station 11), and the lowest was 0.000 mg/l in August in Bear Creek near Pleasant Grove Church (Station 2). The sampling date on which the highest and lowest chlorophyll *a* concentrations were observed varied among the sampling stations within the Bear Creek watershed. In a report on the water quality characteristics of Delta lakes, Lucas (1988) indicated that fishermen perceive lakes with chlorophyll *a* concentrations lower than 0.0146 mg/l to be in good to excellent shape.

Chlorophyll *a* concentrations are one of the indicators of the eutrophic state of a body of water. The higher the chlorophyll *a* levels, the more eutrophic the body of water. Eutrophic bodies of water are characterized by large amounts of algae which, in high enough levels, can give the body of water a greenish color. Adequate nutrients are present in the waters of Bear Creek for the chlorophyll *a* levels to be higher than they are. One possible reason that chlorophyll *a* levels are so low is that the suspended solids and turbidity decrease light penetration, thereby decreasing the amount of algae.

Nutrients and organic carbon

Water samples collected during 1990 were analyzed to determine the concentrations of nitrogen, phosphorus, and organic carbon. Three forms of nitrogen were measured: organic nitrogen (ON), ammonia nitrogen (NH_3-N), and nitrate-nitrite nitrogen (NO_3/NO_2-N). Phosphorus and organic carbon were measured in their total (TP and TOC) and dissolved forms (TDP and DOC). All nutrient and organic carbon data from 1990 are contained in Table B3 of Appendix B. These data were compared to data collected during the 1976-79 USDA study of Bear Creek. These comparisons and their discussions are presented in the following sections. No TOC or DOC data were collected during the USDA study.

With the exception of nitrate (NO_3), there are no State criteria for acceptable levels of either the nutrients or organic carbon. Where possible, information is presented which will help in the interpretation of the data.

Nitrogen. During the 1990 sampling, ON concentrations in the Bear Creek watershed varied from 0.33 mg/l in Three Mile Lake (Station 8) in June to 2.21 mg/l in Bear Creek near McCoy Lake (Station 5a) in August. Organic nitrogen was the predominant nitrogen species throughout the watershed with its concentration at times being an order of magnitude greater than the NH_3-N or NO_3/NO_2-N concentrations. The ON concentration was fairly uniform throughout the watershed with most samples having ON concentrations between 0.75 and 1.25 mg/l.

The NH_3-N concentrations ranged from below 0.01 mg/l to 0.24 mg/l. Both of these values were observed in Blue Lake (Station 1). The minimum was observed in June and the maximum in October. NH_3-N concentrations tended to be higher in the upper portion of the watershed than in the lower portion. The NH_3-N concentrations were much lower in the 1990 samples than in samples taken in the 1976-79 USDA study. An example of this is shown in Figure II-5. During the USDA study, NH_3-N concentrations greater than 1.0 mg/l were repeatedly observed whereas, during 1990, only nine samples had NH_3-N concentrations greater than 0.1 mg/l. The data from the USDA study indicated that NH_3-N concentrations fluctuated considerably and that concentrations greater than 1.0 mg/l were observed throughout the year. Techniques used for ammonia measurement in the USDA study differed from those used in the current study. Differences in these techniques could possibly be the reason the levels observed in 1990 were so much lower than those observed in the USDA study.

The NO_3/NO_2-N concentrations ranged from a minimum of 0.02 mg/l in October in Macon Lake (Station 7) to a maximum of 1.7 mg/l in June in Three Mile Lake (Station 8). The lowest NO_3/NO_2-N concentrations observed at each individual station were seen during the October sampling. The State of Mississippi maximum allowable limit of NO_3 in waters which will be used for water supplies is 10.0 mg/l. This limit is based on the adverse health effects (methemoglobinemia) that high NO_3 levels can have upon infants.

The NO_3/NO_2-N data collected during 1990 were compared to NO_3 data collected during the 1976 to 1979 USDA study. In the 1976 to 1979 USDA study, NO_3 concentrations ranged from 0.023 to 2.214 mg/l. These comparisons are possible because NO_2 concentrations in the natural environment are low in comparison to those of NO_3. Also, NO_2 that is present is readily oxidized to NO_3. Therefore, the NO_3/NO_2-N concentrations measured are predominantly NO_3. The magnitude of NO_3/NO_2-N concentrations measured during 1990 throughout Bear Creek are similar to NO_3 concentrations observed in the 1976-79 USDA study. Fluctuations observed in NO_3/NO_2-N concentrations during 1990 are also similar to those observed in NO_3 concentrations during the 1976-79 USDA study.

Phosphorus. Total phosphorus (TP) concentrations in Bear Creek during 1990 ranged from 0.07 mg/l in Blue Lake (Station 1) in August to 0.70 mg/l in Bear Creek near Pleasant Grove Church (Station 2) in April. When TP concentrations exceed 0.020 mg/l, enough phosphorus is available for the lake to be eutrophic to some degree (Lucas 1988). The degree to which the lake is eutrophic is dependent upon the TP concentration. While TP concentrations exceeded 0.020 mg/l for all samplings at all stations, Bear Creek and its lakes did not appear to be overly eutrophic. As explained earlier, the fact that the lakes and Bear Creek did not seem eutrophic appears to be due to the inability of sunlight to penetrate the turbid waters rather than the lack of nutrients.

The highest values of TP were observed during the April and June samplings. These high values are probably the result of runoff from agricultural fields on which fertilizers had been applied during the spring. TP concentrations exceeded 0.10 mg/l for all samplings at all stations except for Blue Lake (Station 1), Mossy Lake (Station 6), and Macon Lake (Station 7). At these stations the lowest TP concentration observed was 0.07 mg/l during the August sampling. Only in Bear Creek below Old Dominion Plantation (Station 5) and near McCoy Lake (Station 5a) were TP concentrations higher than 0.5 mg/l observed in 1990. TP concentrations of 0.64 mg/l and 0.58 mg/l were observed during the April samplings at these stations.

Total dissolved phosphorus (TDP) concentrations in Bear Creek ranged from 0.02 mg/l below Old Dominion Plantation (Station 5) to 0.27 mg/l near Pleasant Grove Church (Station 2). Both of these concentrations were observed during the April sampling. During 1990, the TDP concentrations were generally higher in the upper portion of Bear Creek (Stations 1 through 5a). The highest TDP concentrations were measured in Blue Lake (Station 1) and in Bear Creek near Pleasant Grove Church (Station 2) and at New Home Church (Station 3) during the April sampling. For subsequent samplings at these stations, TDP levels were lower but not as low as the TDP concentrations of the lower portion of Bear Creek. Below Three Mile Lake (Station 8), the maximum TDP concentration observed in 1990 was 0.08 mg/l in Six Mile Lake (Station 9) in June. Most stations in this region had TDP concentrations around 0.05 mg/l.

In comparison to data from the 1976-79 USDA study, TP levels of the Bear Creek watershed appear to be lower in 1990. During the 1976-79 study, TP concentrations near or exceeding 1.0 mg/l were observed repeatedly throughout the watershed. TDP concentrations were also lower than those observed during the 1976-79 USDA study. In 1990 most TDP concentrations were less than 0.1 mg/l whereas TDP concentrations exceeding 1.0 mg/l were observed during the 1976-79 USDA study in the upper portion of Bear Creek.

During the 1976-79 USDA study, data were collected at much shorter intervals (2 weeks) than in the current study. The data from the USDA study indicated that TP and TDP concentrations could fluctuate significantly within the 2 weeks between samplings. In the current study, the degree of fluctuation seen repeatedly in the USDA study was not observed.

Organic carbon. Total organic carbon (TOC) concentrations were fairly uniform throughout the watershed during 1990. The minimum TOC observed in Bear Creek was 4.1 mg/l in August near Morgan City (Station 4) and the maximum was 9.0 mg/l in October near Pleasant Grove Church (Station 2). The TOC concentrations were lowest at Mossy Lake (Station 6) and Macon Lake (Station 7), with TOCs ranging between 4.3 and 5.0 mg/l throughout the study TOC in the upper portion of the watershed (Stations 1 through 4) was slightly higher than TOC in the lower watershed (Stations 9 through 11).

Dissolved organic carbon (DOC) concentrations were always very close to those of the TOC (Figure II-6). The maximum difference between the TOC and DOC was 0.6 mg/l in August in Three Mile Lake (Station 8). At all other times the DOC was within 0.3 mg/l or less of the TOC, which means that essentially all of the TOC is dissolved and not associated with suspended matter. This DOC is probably in the form of humic and fulvic acids which are produced by the decay of organic material such as leaves and branches. Drever (1988) indicated that the average DOC concentration in lakes and rivers is 4 to 6 mg/l.

Pesticides

Water samples for pesticides were collected at 11 stations (Figures II-1 and Table II-3) in Bear Creek (BC) in April, June, and October 1990. Four samples were collected in August (Blue Lake, BC at Morgan City, Three Mile Lake, and Wasp Lake; Stations 1, 4, 8, and 11, respectively). Water samples were analyzed according to the methods given in Appendix A. Five soil samples (Table II-8) for pesticide analysis were collected from a previously sampled watershed near Three Mile Lake, Station 8 (Cooper et al. 1987). A sufficient volume of soil for analytical purposes was removed to a plow depth of 8 to 12 inches in April 1990. Soil samples were analyzed according to the methods given in Appendix A.

Surface water. Several pesticides were detected in the April, June, August, and October samples of Bear Creek (Tables II-9 and II-10). The insecticide Heptachlor (HPTCL) was detected in six stations in April, three stations in August, but only once in June. Heptachlor was also present in two stations in the October samples of Bear Creek, but the blank in the analysis showed contamination, thus decreasing the confidence in the quantity. Endosulfan sulfate (ENDOSU) was detected in two stations in April, was present in five stations in June and three in August, but was not detected in October. The other detected chlorinated insecticides were PPDDD (twice in April and June), PPDDT and PPDDE (once in April), and DIELDRIN (once in April and August). DIELDRIN contamination in the blank was present in the August sample, thus decreasing the confidence in the analysis. PPDDD, PPDDT, DIELDRIN, and HPTCL are no longer used in the United States (Thomson 1989a); however, ENDOSU has not been banned (Thomson 1989a). PPDDE, the main metabolite of PPDDT, forms readily by dehydrochlorination under alkaline conditions (Buchel 1983). Since PPDDE has no insecticidal properties, it has not been applied on agricultural fields; therefore, its presence implies PPDDT or PPDDD transformation in the fields.

Two additional pesticides, the phenoxyacetic acid herbicide 2,4,5-T and the organic phosphate insecticide ethyl trithion (ETTRITH), were detected in October (Table II-12). The herbicide 2,4,5-T is normally used to control woody plants and broadleaf weeds, and is often formulated with 2,4-D. A teratogenic effect of 2,4,5-T, observed in animal experiments with the technical product, was traced back to contamination with dioxin in the manufacturing process (Buchel 1983). If used at the recommended dosages, 2,4,5-T (like 2,4-D) will not accumulate in the soil from one year to another (Thomson 1989b).

ETTRITH was found in three stations in Bear Creek--Blue Lake (Station 1), BC near Pleasant Grove Church (Station 2), and Macon Lake (Station 7)--in October. This was the highest observed concentration of any pesticide in the UYP study (Table II-12). ETTRITH is an organic phosphate insecticide with a relatively short half-life, but extremely toxic, as are all the insecticides of this group. The organic phosphate insecticides that were sampled for in this study are listed under currently used pesticides in Table II-5, with the exception of METHOMYL, a carbamate insecticide. Half-life on the soil for this group ranges from 1 week to less than 6 months (Ruiz 1979). The relatively short half-life is an indication of low persistence.

ENDOSU has a much lower persistence than most chlorinated insecticides; therefore, its detection infers recent application. The same is true of 2,4,5-T and ETTRITH. Overall, concentrations of the pesticides in Bear Creek were very close to the detection limits of 10 parts per trillion (pptr), except for 2,4,5-T and ETTRITH. The values found in 1990 are at the lower end of those in the 1980s (Cooper et al. 1987). Pesticide levels in April do not differ from those in June and August. The October data show that for the chlorinated insecticides, the levels at this later sampling do not differ from the previous three sampling events; however, 2,4,5-T and ETTRITH show recent application and a much higher concentration in the aquatic environment than in April, June, and August.

Figures II-7 through II-10 show the concentrations, over time, of the chlorinated insecticides PPDDT, PPDDD, PPDDE, DIELDRIN, HPTCL, and TOXAPHEN at Blue Lake (Station 1), BC near Morgan City (Station 4), BC near McCoy Lake (Station 5A), and Wasp Lake (Station 11), respectively. Figures II-7 to II-10 include both the old data (USDA study from 1976 to 1979) and the current study for Bear Creek. The PPDDD concentration in Blue Lake (Figure II-7) was typical of most of the chlorinated insecticides, i.e, high in the early 1970s decreasing to less than detection limits (ND) in the early 1980s and 1990s. These figures show that most of the surface water concentrations of chlorinated insecticides in the Bear Creek watershed were below detection in the 1990 study, and those detected are less than an order of magnitude above the detection limits. Figures B-5, B-6, B-7, and B-8 show the historical data (USDA 1976 to 1979) at four sites in Bear Creek: Blue Lake (Station 1), Macon Lake (Station 7), Three Mile Lake (Station 8), and BC at Swiftown (Station 9). Figures II-7 through II-10 and B1 through B4 illustrate two important trends: the pesticide concentration is decreasing over time, and the number of samples with concentrations below the detection limit is increasing over time. Samples with concentration below the detection limit lie on the axis of the figures; therefore, values of not detected (ND) or less than (<) were set at 0.009 parts per billion (ppb), regardless of the actual detection limit. The actual detection limits for chlorinated insecticides varied; 0.1 ug/l in 1977, 0.1 ug/l (1.0 ug/l for TOXAPHEN) in 1978, 0.01 ug/l in 1979, and 0.00001 mg/l (0.0002 mg/l for TOXAPHEN) in 1990.

In Figures II-7 through II-10 and B-5 through B-8, the historical data from 1976 to 1979 showed a distinct pattern of high concentrations of several pesticides, which decreased to a plateau of about an order of magnitude above the detection limit in 1979. In particular, PPDDE and DIELDRIN showed such behavior, and to a less extent PPDDD and PPDDT. TOXAPHEN exhibits a declining pattern over the 4-year study, while HPTCL shows a more random pattern.

Soil cores. Soil cores were collected to compare the pesticide levels in a typical watershed of Bear Creek to historical data. Stower's Farm was selected because soil pesticide data were obtained in an early Soil Conservation Service (SCS) study (Cooper et al. 1987). Five soil samples (Table II-8) were collected for pesticide analysis from a previously sampled watershed (Stower's Farm) between Macon Lake (Station 7) and Three Mile Lake, (Station 8) (Cooper et al. 1987). Pesticides were detected in all but one of the cores (Tables II-13). The sum of PPDDT, PPDDE and PPDDE (ND - 476 ppb) and TOXAPHEN (21-2270 ppb) were the only pesticides reported in the SCS study (Cooper et al. 1987). Neither PPDDT nor TOXAPHEN was detected in the 1990 study; however, the PPDDT metabolites, PPDDD and PPDDE, were both present in the April 18, 1990 samples. HEPTCL was much lower in the current study (1.6 ppb) than the 7.4 ppb reported for 1979 (USDA 1981). Soil analyses for TOC and particle size (Table II-14) do not offer any explanation for the non-uniform pesticide distribution in the soil samples.

Overall, pesticide concentrations in the water and soils of Bear Creek, especially the organochlorine insecticides PPDDT and TOXAPHEN, were lower than in 1980. PPDDT metabolites were present in both water and soil in the Bear Creek area, but at a much lower concentration than reported in previous years (USDA 1976 to 1979, USDA 1981, Cooper et al. 1987). High concentrations of pesticides persist, stored in some agricultural fields of the Bear Creek watershed. Surface waters in Bear Creek showed a substantial decrease of the chlorinated insecticides compared with historical values. New insecticides and herbicides, e.g., Atrazine, Metrabuzin, ETTRITH, TRIFLURA, and 2,4,5-T, were found in the Bear Creek water bodies, but in concentrations lower than the historical data for the chlorinated insecticides. Although detected, the new products are less persistent than their chlorinated counterparts and pose a lower risk of biomagnification because of their chemical properties.

Tables B1, B2, and B3 (Appendix B) list the water quality data for the Bear Creek stations. Tables B4 through B15 list the pesticide data for Bear Creek. Tables B4 through B7 contain the chlorinated insecticide data for the four sampling events; Tables B8 through B11, the currently used insecticides data; and Tables B12 through B15, the herbicide data. Figures B-5 through B-8 illustrate the pesticide historical data from a previous study (USDA 1976 to 1979).

Yazoo River

General description

The drainage basin of the Yazoo River encompasses 13,355 square miles bordered on the north by the drainage divides of the Wolf and Hatchie River basins, on the east and south by the Tombigbee and Big Black River basins, and on the west by the levees that flank the Mississippi River (Vicksburg District 1976). The basin is divided into two different topographic regions of similar areas: the "flat delta" to the west and the "hill" region to the east (Figure II-11). The principal tributaries of the Yazoo River are the Tallahatchie, Coldwater, Big Sunflower, and Yalobusha Rivers. The Soil Conservation Service estimated in 1970 that erosion in the basin was more than 28 million tons per year of which over 50 percent was carried by tributaries of the Yazoo River (USF&WS 1979). One of the primary reasons for the erosion is the conversion of bottomlands into row-crop production and the cultivation of marginal lands in the "hill" section.

Bottomland hardwoods and other overflow areas are major contributors to the production of fish and wildlife in the Yazoo Basin (USF&WS 1979). Flooding and recession of water in bottomlands recycle nutrients and purify the water returning to the system. That cycling makes bottomland hardwoods one of the most productive systems in nature. Therefore, the conversion of bottomlands to agriculture decreases the assimilative capacity of the system and increases the potential load of organic and inorganic materials from cultivated soil.

The objective of this study was to describe the impacts of land-use changes (conversion of natural lands to agricultural lands) on water quality in the UYP. This objective will be accomplished by comparing and contrasting historical and present trends in water quality in the basin.

General water quality

Conventional parameters. Two sampling events at three stations were conducted to assess current trends in water quality in the Yazoo River. Samples were collected where historical data existed. The three selected sites are presented in Figure II-12 and Table II-15. The first sampling event was scheduled for April 1990; the second, for October 1990. At each station, conventional water quality parameters were measured (Table II-4), as were insecticides and herbicides (Table II-5).

Figures II-13 through II-16 show historical data from the Water Quality STOrage and RETrival system (STORET) for the Yazoo River at Shell Bluff compared to the current study (discrete points). Dissolved oxygen was above the minimum (4 mg/l) and the recommended water quality criteria (5 mg/l) of the State of Mississippi (MDEQ 1990), but at least one unit below saturation (Tables II-16 and II-17). The DO, temperature, pH, and conductivity were fairly uniform with depth (Table II-17) in the October sample at Belzoni (Station 1), indicating a well-mixed system. Figure II-13 shows the historical data and the current data. The two 1990 sampling events fall in the lower range of the historical data. The pH was within the acceptable range for natural freshwater systems (6.5-8.5). Figure II-14 contrasts the historical data and the 1990 data. Values for DO and pH also fall in the lower range of the historical data for the Yazoo River at Shell Bluff (Station 3). Conductivity results (Table II-16) appear reasonable and within the ranges of the historical data archived in STORET (Figure II-15) for the Yazoo River at Shell Bluff.

Turbidity was above the recommended limit of 80 NTU (Cotton 1976); however, high suspended solids were expected in April, a high-water period (Table II-16). Turbidity levels are important to sensitive aquatic species, but are not as relevant in a system like the Yazoo River, since most of its species are less sensitive to high suspended solids.

Table II-18 lists the results for solids, organic carbon, and nutrients. Suspended solids results are within the range of historical data for the Yazoo River at Shell Bluff, as can be observed from Figure II-16. The TOC and DOC values are virtually identical, indicating that most of the particulate or suspended matter in the Yazoo River tends to be of inorganic nature (sands and clays). Nutrients are lower than those found in the Bear Creek watershed, in particular ON. The ON was fairly uniform in all the stations at different sampling dates and very close to the historical mean, 0.65 mg/l, at the Yazoo

River station of Shell Bluff (STORET). Total phosphorus also exhibited similar behavior. Chlorophyll *a* levels in the Yazoo River were fairly low in both sampling events (Table II-18). Adequate nutrients occur in the river for the chlorophyll *a* levels to be higher, but high turbidity decreases light penetration, thus inhibiting algal growth.

<u>Pesticides: surface water.</u> No pesticides were detected (ND) in surface water samples in April 1990 (Table II-19). The chlorinated insecticide HPTCL was detected in an October sample (Table II-20) from the Yazoo River at Belzoni (Station 1); however, the analysis for the blank showed HPTCL contamination, and thus the results cannot be quantified. The phenoxyacetic herbicide 2,4,5-T was also detected in the October sample at Silent Shade (Station 2) and Shell Bluff (Station 3); however, the concentration at Shell Bluff was below the quantifiable limits of the analysis.

Total pesticide concentrations in 1980 water samples in the vicinity of Belzoni (Station 1) (Brightbill and Treadaway 1980) were 20 to 32 ppb PPDDD, 14 to 31 ppb PPDDT, 10 to 14 ppb DIELDRIN, 10 to 20 pptr 2,4-D, and 40 to 100 pptr 2,4,5-T. Total pesticide concentrations in 1980 water samples in the vicinity of Silent Shade (Station 2) (Brightbill and Treadaway 1980) were ND to 12 ppb PPDDD, ND to 11 ppb PPDDT, ND to 8 ppb DIELDRIN, 90 to 380 pptr 2,4,5-T, and 20 pptr 2,4-D. Total pesticide concentrations in 1980 water samples in the vicinity of Shell Bluff (Station 3) (Bednar and Grantham 1980) were ND to 2 pptr PPDDD, ND to 4 pptr PPDDT, ND to 2 pptr DIELDRIN, 30 pptr 2,4-D, and 10 pptr 2,4,5-T.

STORET data for the Yazoo River near Shell Bluff showed 2,4,5-T in the water at 10 pptr in December 1979, March 1982, and May 1982. Even though the 1990 concentration at Shell Bluff (Station 3) was below accurately quantifiable detection limits, it is probably of the same magnitude as the STORET historical data and previous study (Bednar and Grantham 1980). Although present at Shell Bluff (Station 3), 2,4,5-T was not quantifiable in our sampling (Table II-20). However, the concentration at Silent Shade (Station 2), which was 1.1 ppb, was higher than the STORET historical data for 2,4,5-T at Shell Bluff (0.01 ppb), and somewhat higher than data from the USGS study (0.38 ppb) (Brightbill and Treadaway 1980). Concentrations of 2,4-D (STORET) at the Yazoo River near Shell Bluff ranged from 30 to 490 pptr. The upper range of the 2,4-D concentration was of the same magnitude as the 2,4,5-T concentration at Station 2 in 1990 (Table II-20).

Overall, the organochlorine insecticide concentrations in the Yazoo River are lower than in the early 1970s and 1980s, in particular the more persistent ones such as PPDDT and DIELDRIN. The concentrations of chlorinated insecticides in the Yazoo River are similar in magnitude to those in the Bear Creek watershed. The phenoxyacetic herbicides, 2,4-D and 2,4,5-T, are still used in the basin and occur in the runoff at concentrations similar to the historical data.

Tables C1 through C6 (Appendix C) list the surface-water pesticide data for the Yazoo River stations.

Pesticides: bank cores. Bank core material was sampled at six sites along the Yazoo River (Table II-21). Stations were located as close as possible to those of the original US Geological Survey (USGS) sampling (Bednar and Grantham 1980, Brightbill and Treadaway 1980, Leone and Dubuy 1978.) The bank cores were collected with a soil auger by WES and Vicksburg District personnel. Methods for determining soil particle size and TOC are given in Appendix A. Results are presented in Table II-14.

All pesticides were below detection limits at Stations ST6 and ST11 (Table II-19). PPDDE, PPDDD and HPTCL were the only pesticides detected in the bank core samples. PPDDE was detected in most stations, while PPDDD was detected in Station ST8 and two samples of Station ST12. HPTCL was detected in the ST12-F core only.

At Station ST12 the soil core was split into two segments: a shallow core (ST12-T) composed of the top 1 ft, and a deep core (ST12-B) composed of the bottom 4 ft. An additional core (ST12-F) was taken 100 ft to the east in a shallow drainage depression at the edge of a cotton field.

The highest pesticide concentration (0.115 mg PPDDE/kg sediment) was measured in ST12-F. The sample was high in both TOC (8,500 mg/kg) and silt (62.5%). These characteristics and the sample location help explain the high PPDDE value and the detection of HPTCL. Soil, particularly the components silt, clay, and organic matter, had been deposited in this depression from the cultivated fields where past applications of PPDDT and other organochlorine insecticides were common. Both PPDDE and PPDDD concentrations were higher in ST12-B than in ST12-T, which was lower in silt and TOC (Table II-14).

The pesticide data from bank cores were compared with data collected in 1980 by the USGS (Bednar and Grantham 1980, Brightbill and Treadaway 1980). Overall, pesticide concentrations were lower in 1990 than in 1980 (Table II-22), except at Stations ST17, ST15, and ST12-B. One explanation for the apparently higher concentrations in the 1990 data at the two stations is differences in sample collection (depth of the cores). In 1980 most samples were taken to depths between 30 and 40 ft and composited before analysis, while in 1990 cores were between 4 and 5 ft. For example at Station 12 the core was 39 ft, while Station 12A, one of two shallow cores, was 3 ft. Significantly different pesticide concentrations were obtained for these two samples (Table II-22). Measuring the concentration of pesticides in a composite sample of 39 ft of soil produces a lower concentration of pesticide than measuring the surface only because the pesticide concentration is usually higher at the upper level of the soil. A better comparison could be made between the 1990 cores and 1980 shallow cores. However, no shallow cores for Stations ST15 and ST17 were taken in 1980.

The apparently higher concentration at some of the stations can be explained by the degradation/conversion of PPDDT to PPDDE and PPDDD in the system. No PPDDT was detected in 1990, while PPDDT levels in 1980 were as high or higher than PPDDE and PPDDD.

Overall, pesticide concentrations in soil bank cores, especially the organochlorine insecticides, were lower than in 1980. Some PPDDD and PPDDE remain in soils. Where fine sediments from agricultural fields accumulate, the concentration of some pesticides is still significant. Pesticides adsorbed to the fine sediment and organic matter serve as potential contaminants in runoff to the aquatic system through erosion.

Impacts of land-use changes on water quality for the Yazoo River Basin are hard to generalize due to changes that the basin is presently undergoing. Two major land-use changes are taking place in the area: the conversion of crop land to catfish ponds and, to a smaller extent, conversion of forest land to crop land. In the conversion of land to catfish ponds, adverse impacts from pesticides and other agrochemicals are reduced. However, significant non-continuous point load discharges of suspended solids, BOD, and nutrients are created which impact the dissolved oxygen and the productivity of the system.

The conversion of forest land to crop land impacts the aquatic system because of the probable increase of suspended sediment load, unless agricultural best management practices are in effect to reduce soil loss. Loading of chlorinated insecticides should not result from conversion of forested land to crop land, since those pesticides were not applied to forested land and are not used in present-day agriculture. However, loadings from other agrochemicals will continue to increase if more land is put into crop production with present-day agricultural practices.

Table II-1

Principal Lakes Along Bear Creek

Lake	Station Number	Length (miles)	Surface Area (acres)
Blue Lake	1	2.5	32
One Mile Lake	ns*	0.75	16
Mossy Lake	6	3.0	190
Macon Lake	7	1.0	39
Three Mile Lake	8	1.5	70
Six Mile Lake	9	3.5	110
Four Mile Lake	10	2.5	135
Wasp Lake	11	6.25	325

* ns - not sampled

Table II-2

Bear Creek Watershed Crops and Land-Use

Agricultural	Acres	Percent of Watershed
Cotton	28,130	33.4
Soybeans	14,300	17.0
Other row crops (rice, sorghum, corn)	10,140	12.0
Agricultural Crop Reduction*	5,780	6.9
Pasture (including winter wheat)	5,300	6.3
Catfish ponds	2,810	3.3
Nonagricultural		
Bottomland hardwoods	14,790	17.6
Lakes and streams	2,874	3.4
Other	150	0.1
Total	84,280	100.0

* Land removed from crop production in order to qualify for government subsidies. Acreages compiled from satellite imagery maps of land use (1988).

Table II-3

Bear Creek Sampling Stations

Station	Miles above Yazoo River Confluence	Description
1	49.1	Bridge across Blue Lake at community of Berclair
2	46.6	Bridge southeast of Pleasant Grove Church
3	43.6	Bridge near New Home Church
4	38.8	Bridge across Bear Creek north of Morgan City
5	36.5	Bridge southwest of Old Dominion Plantation
5a	30.2	Bridge across Bear Creek west of McCoy Lake
6	*	Wooden bridge across Mossy Lake near Peteet
7	*	Bridge across Macon Lake
8	25.0	Bridge across Three Mile Lake
9	17.5	Bridge across Bear Creek at Swiftown
10	12.8	Highway 7 Bridge across Bear Creek south of Swiftown
11	2.2	Bridge across Wasp Lake at Deovolente

* These lakes lie along Bear Creek, but are not normally connected to it.

Table II-4

Routine Water Quality Parameters*

In-Situ Parameters	Physicochemical Parameters
Temperature (Temp)	Total Solids (TS)
Dissolved Oxygen (DO)	Total Suspended Solids (TSS)
pH	Turbidity (Turb)
Specific Conductance (Cond)	Total Organic Carbon (TOC)
	Dissolved Organic Carbon (DOC)
	Organic Nitrogen (ON)
	Nitrate/Nitrite Nitrogen (NO_3/NO_2-N)
	Ammonia Nitrogen (NH_3-N)
	Total Phosphorus (TP)
	Total Dissolved Phosphorus (TDP)
	Chlorophyll *a* (Chla)

* Abbreviations used throughout the report are given in parentheses.

Table II-5

Insecticides, Herbicides and PCBs*

Chlorinated Insecticides	Currently Used Insecticides	Herbicides
Aldrin (ALDRIN)	Diazinon (DIAZINON)	2,4-D (2,4-D)
α-BHC (A-BHC)	Ethyl Parathion (ETPATH)	2,4-DP (2,4-DP)
β-BHC (B-BHC)	Ethyl Trithion (ETTRITH)	2,4,5-T (2,4,5-T)
δ-BHC (D-BHC)	Ethion (ETHION)	2,4,5-TP (2,4,5-TP)
γ-BHC (Lindane)(G-BHC)	Malathion (MALATH)	2,4-DB (2,4-DB)
Chlordane (CHLORDANE)	Methyl Parathion (METPATH)	Trifluralin (TRIFLURA)
4,4'-DDD (PPDDD)	Chlorpyrifos (CHLPYFOS)	
4,4'-DDE (PPDDE)	Dicrotophos (DICRPHOS)	
4,4'-DDT (PPDDT)	Azodrin (AZODRIN)	
Dieldrin (DIELDRIN)	Methomyl (METHOMYL)	
Endosulfan I (ENDOI)	Azinphosmethyl (AZPHMETH)	
Endosulfan II (ENDOII)	Sulprofos (SULPROFO)	PCB Congeners
Endosulfan Sulfate (ENDOSU)	Methamidophos (METAMIPH)	Aroclor 1016
Endrin (ENDRIN)		Aroclor 1221
Endrin aldehyde (ENDALD)		Aroclor 1232
Heptachlor (HPTCL)		Aroclor 1242
Heptachlor epoxide (HPTCLE)		Aroclor 1248
Methoxychlor (METOXYCL)		Aroclor 1254
Toxaphene (TOXAPHEN)		Aroclor 1260

* Abbreviations used throughout the report are given in parentheses.

Table II-6

Dissolved Oxygen Values Not Meeting State of

Mississippi Criteria

Station	Year*	Total Samples	DO less than 5 mg/l	DO less than 4 mg/l	1990 Minimum mg/l
1	1976	24	13	10	
	1977	26	4	4	
	1978	18	2	2	
	1979	26	4	4	
	1990	4	2	1	2.8
2	1976	24	20	19	
	1977	26	10	8	
	1978	23	6	5	
	1979	19	6	6	
	1990	4	4	4	1.0
3	1976	19	11	6	
	1977	17	6	4	
	1978	17	5	3	
	1979	16	4	3	
	1990	2	0	0	5.2
4	1976	24	13	11	
	1977	25	5	3	
	1978	26	5	4	
	1979	18	4	2	
	1990	4	2	2	2.5
5	1976	25	11	7	
	1977	26	7	6	
	1978	26	2	1	
	1979	17	5	4	
	1990	1	0	0	8.4

(Continued)

* All data, except for 1990, are from USDA Quarterly Progress Reports June 1976 through September 1979 (USDA 76a-b, 77a-d, 78a-d, 79a-d).

(Sheet 1 of 3)

Table II-6 (Continued)

Station	Year*	Total Samples	DO less than 5 mg/l	DO less than 4 mg/l	1990 Minimum mg/l
5a	1976	14	9	7	
	1977	26	6	4	
	1978	25	1	1	
	1979	18	0	0	
	1990	4	3	1	3.0
6	1977	7	0	0	
	1978	26	0	0	
	1979	18	1	0	
	1990	4	0	0	5.9
7	1977	7	0	0	
	1978	26	0	0	
	1979	18	2	0	
	1990	4	0	0	6.5
8	1976	24	7	5	
	1977	26	3	2	
	1978	25	2	1	
	1979	18	2	0	
	1990	4	1	1	3.6
9	1976	24	5	5	
	1977	26	3	2	
	1978	26	3	2	
	1979	18	5	2	
	1990	4	0	0	5.0
10	1976	24	7	4	
	1977	26	6	0	
	1978	26	4	1	
	1979	18	1	0	
	1990	4	1	1	4.7

(Continued)

* All data, except for 1990, are from USDA Quarterly Progress Reports June 1976 through September (USDA 76a-b, 77a-d, 78a-d, 79a-d).

(Sheet 2 of 3)

Table II-6 (Continued)

Station	Year*	Total Samples	DO less than 5 mg/l	DO less than 4 mg/l	1990 Minimum mg/l
11	1976	24	4	4	
	1977	26	2	0	
	1978	26	1	0	
	1979	18	1	0	
	1990	4	0	0	6.7

* All data, except for 1990, are from USDA Quarterly Progress Reports June 1976 through September 1979 (USDA 76a-b, 77a-d, 78a-d, 79a-d).

(Sheet 3 of 3)

Table II-7

Solids Data for Bear Creek Watershed

Station	Total Solids (mg/l)				Suspended Solids (mg/l)				Dissolved Solids* (mg/l)			
	April	June	Aug	Oct	April	June	Aug	Oct	April	June	Aug	Oct
1	90	75	90	126	13	14	<4	54	77	61	>86	72
2	104	85	96	110	6	18	12	40	98	67	84	70
3	109	88	ns**	ns	31	23	ns	ns	78	65	--	--
4	154	145	255	170	50	87	24	30	104	58	231	140
5	380	ns	ns	ns	267	ns	ns	ns	113	--	--	--
5a	334	272	247	257	252	181	10	74	82	91	237	183
6	179	193	128	173	62	50	<4	52	117	143	>124	121
7	122	82	55	99	24	14	<4	56	98	68	>51	43
8	200	318	238	207	110	223	32	66	90	95	206	141
9	167	185	159	175	38	63	34	74	129	122	125	101
10	216	226	121	147	30	51	20	70	186	175	101	77
11	209	212	180	180	57	63	22	102	152	149	85	78

* Dissolved solids data were calculated from measured TS and TSS data.

** ns - not sampled. In cases where TS and TSS data were not collected, no dissolved solids concentrations could be calculated. These instances are denoted by --.

Table II-8

Station Description - Field Samples Taken from Stower's Farm

Station	Description
STOW1	100 ft north of road, 200 ft east of Three Mile Lake
STOW2	600 ft north of road, 200 ft east of Three Mile Lake
STOW3	600 ft north of road, 700 ft east of Three Mile Lake
STOW4	600 ft north of road, 200 ft west of Macon Lake
STOW5	100 ft north of road, 200 ft west of Macon Lake

Table II-9

Pesticides in Water Samples from Bear Creek, April 18, 1990

Station	River Mile	DIELDRIN (mg/l)	PPDDD (mg/l)	PPDDE (mg/l)	PPDDT (mg/l)	HPTCL (mg/l)	ENDOSU (mg/l)
1	49.9	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001***	**0.00001**
2	48.2	<0.00001	<0.00001	<0.00001	<0.00001	**0.00003**	<0.00001
3	46.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
4	44.2	<0.00001	**0.00001**	**0.00001**	<0.00001	**0.00001**	<0.00001
5a	36.9	**0.00001**	**0.00002**	<0.00001	**0.00002**	**0.00002**	**0.00001**
6	30.6	<0.00001	<0.00001	<0.00001	<0.00001	**0.00004**	<0.00001
7	28.8	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
8	24.9	<0.00001	<0.00001	<0.00001	<0.00001	**0.00002**	<0.00001
9	18.0	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
10	13.4	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

* Values presented in bold-face type are above detection limits.

Table II-10

Pesticides in Water Samples from Bear Creek, June 7, 1990

Station	River Mile	PPDDD (mg/l)	PPDDE (mg/l)	PPDDT (mg/l)	HPTCL (mg/l)	DIELDRIN (mg/l)	ENDOSU (mg/l)
1	49.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
2	48.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001**
3	46.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001**
4	44.2	**0.00001**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
5A	36.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00002**
6	30.6	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
7	28.8	<0.00001	<0.00001	<0.00001	**0.00001**	<0.00001	<0.00001
8	24.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00002**
9	18.0	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001**
10	13.4	**0.00001**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Table II-11

Pesticides in Water Samples from Bear Creek, August 29, 1990

Station	River Mile	PPDDD (mg/l)	PPDDE (mg/l)	PPDDT (mg/l)	HPTCL (mg/l)	DIELDRIN (mg/l)	ENDOSU (mg/l)
1	49.9	<0.00001	<0.00001	<0.00001	0.00008	<0.00001	0.00002
4	44.2	<0.00001	<0.00001	<0.00001	0.00005	<0.00001	0.00004
8	24.9	<0.00001	<0.00001	<0.00001	0.00001	0.00001	0.00002
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
METHOD BLANK		<0.00001	<0.00001	<0.00001	<0.00001	0.00003	<0.00001

Table II-12

Pesticides in Water Samples from Bear Creek, October 10, 1990

Station	River Mile	PPDDD (mg/l)	PPDDE (mg/l)	PPDDT (mg/l)	HPTCL (mg/l)	ETTRITH (mg/l)	2,4,5-T (mg/l)
1	49.9	<0.00001	<0.00001	<0.00001	0.00001	0.0006	<0.0008
2	48.2	<0.00001	<0.00001	<0.00001	<0.00001	0.0098	<0.0008
3	46.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.0008
4	44.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.0008
5A	36.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.0008
6	30.6	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.0008
7	28.8	<0.00001	<0.00001	<0.00001	0.00001	0.0006	<0.0008
8	24.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001J
9	18.0	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001J
10	13.4	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.0012
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.0008
METHOD BLANK		<0.00001	<0.00001	<0.00001	0.00003	<0.00001	<0.0008

J Indicates an estimated value when result is less than the specified detection limit.

Table II-13

Pesticides in Soils from Bear Creek, April 18, 1990

Station	TOC (mg/kg)	B-BHC (mg/kg)	PPDDD (mg/kg)	PPDDE (mg/kg)	PPDDT (mg/kg)	HPTCL (mg/kg)
STOW 1	6410	<0.0002	<0.0002	<0.0002	<0.0002	**0.0016**
STOW 2	7040	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
STOW 3	9000	**0.0016**	**0.0093**	**0.03**	<0.0002	<0.0002
STOW 4	4760	<0.0002	<0.0002	**0.056**	<0.0002	<0.0002
STOW 5	6260	<0.0002	<0.0002	<0.0002	<0.0002	**0.0015**

Table II-14

Particle Size Distribution for Soil Cores from Bear Creek

Station	TOC (mg/kg)	% Clay	% Silt	% Sand
ST17	4790	12.5	42.5	45
ST15	8660	20	60	20
ST12-B	5651	10	25	65
ST12-T	5350	2.5	12.5	85
ST12-F	8500	20	62.5	17.5
ST11	7040	17.5	47.5	35
ST8	5200	30	55	15
ST6	6400	30	52.5	17.5
STOW 1	6410	30	20	50
STOW 2	7040	27.5	17.5	55
STOW 3	9000	20	17.5	62.5
STOW 4	4760	20	22.5	57.5
STOW 5	6260	25	17.5	57.5

Table II-15

Yazoo River Sampling Stations

Station	River Mile	Description
1	117	Old bridge near City Hall, Belzoni
2	132	Silent Shade Bridge
3	150	Shell Bluff Bridge

Table II-16

Yazoo River Surface Water Quality - Field Data

Station	Date	Temp (°C)	DO (mg/l)	pH	Cond (μmhos/cm)	Turb (NTU)	Barometer (mm of Hg)
1	4-17-90	16.5	7.6	7.5	69	90	760
	10-10-90	22.0	7.1	7.4	88	85	760
2	4-18-90	17.0	7.4	6.9	68	90	767
	10-10-90	22.0	7.4	6.2	80	95	760
3	4-18-90	16.5	8.4	6.5	65	90	767
	10-11-90	20.5	7.2	6.8	101	95	760

Table II-17

Yazoo River Water Quality - Field Data with Depth, October 10, 1990

Station	Time	Temp (°C)	DO (mg/l)	pH	Cond (μmhos/cm)	Depth (ft)
1	10:16	22.0	7.1	7.4	88	1.0
	10:17	22.0	6.7	7.2	87	5.0

Table II-18

Yazoo River Water Quality - Laboratory Analyses

Station	Date	TS (mg/l)	TSS (mg/l)	Chla (ug/l)	TOC (mg/l)	DOC (mg/l)	ON (mg/l)	NO3/NO2-N (mg/l)	NH3-N (mg/l)	TP (mg/l)	TDP (mg/l)
1	4-17-90	242	130	0.0	3.9	4.1	0.63	0.350	0.050	0.260	0.070
	10-10-90	287	212	1.11	3.6	3.6	0.68	0.210	0.050	0.200	0.080
2	4-18-90	306	177	.ns*	3.7	3.9	0.62	0.450	0.060	0.260	0.040
	10-10-90	345	284	2.67	3.4	3.4	0.65	0.180	0.050	0.180	0.060
3	4-18-90	257	151	.ns*	3.7	4.0	0.56	0.340	0.040	0.260	0.050
	10-11-90	346	258	2.43	3.5	3.5	0.67	0.200	0.050	0.190	0.050

* ns indicates not sampled.

Table II-19

Yazoo River Pesticide Data, April 19, 1990

Water Samples										
Station	Mile	TOC (mg/l)	B-BHC (mg/l)	PPDDD (mg/l)	PPDDE (mg/l)	PPDDT (mg/l)	HPTCL (mg/l)	HPTCLE (mg/l)	TRIFLURA (mg/l)	2,4,5-T (mg/l)
1	117	3.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.0008
2	132	3.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.0008
3	150	3.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.0008

Bank Cores										
Station	Mile	TOC (mg/kg)	B-BHC (mg/kg)	PPDDD (mg/kg)	PPDDE (mg/kg)	PPDDT (mg/kg)	HPTCL (mg/kg)	HPTCLE (mg/kg)	TRIFLURA (mg/kg)	2,4,5-T (mg/kg)
ST17	149.8	4790	<0.0002	<0.0002	**0.0039**	<0.0002	<0.0002	<0.0002	<0.0002	<0.16
ST15	143.5	8660	<0.0002	<0.0002	**0.011**	<0.0002	<0.0002	<0.0002	<0.0002	<0.16
ST11	132.5	7040	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.16
ST12-B*	135.5	5651	<0.0002	**0.0037**	**0.0140**	<0.0002	<0.0002	<0.0002	<0.0002	<0.16
ST12-T	135.5	5350	<0.0002	0.0013	**0.0022**	<0.0002	<0.0002	<0.0002	<0.0002	<0.16
ST12-F	135.5	8500	<0.0002	<0.0002	**0.115**	<0.0002	0.0012	<0.0002	<0.0002	<0.16
ST8	123	5200	<0.0002	**0.003**	**0.004**	<0.0002	<0.0002	<0.0002	<0.0002	<0.16
ST6	111	6400	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.16

* The designation B indicates the bottom 4 ft of the core; T indicates the top 1 ft; and F indicates a field core taken nearby.

Table II-20

Yazoo River Pesticide Data, October 11, 1990

			Water Samples							
Station	Mile	TOC (mg/l)	B-BHC (mg/l)	PPDDD (mg/l)	PPDDE (mg/l)	PPDDT (mg/l)	HPTCL (mg/l)	HPTCLE (mg/l)	TRIFLURA (mg/l)	2,4,5-T (mg/l)
1	117	3.6	<0.00001	<0.00001	<0.00001	<0.00001	0.00004	<0.00001	<0.00005	<0.0008
2	132	3.4	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00005	0.0011
3	150	3.5	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00005	0.0002J
METHOD BLANK			<0.00001	<0.00001	<0.00001	<0.00001	0.00003	<0.00001	<0.00005	<0.0008

J Indicates an estimated value when result is less than the specified detection limit.

Table II-21

Bank Core Sampling Stations

Stations	River Mile	Description
ST17	149.8	On north side of Yazoo River, just downstream of Shell Bluff Bridge. Sample taken 15 ft from edge of water just upstream of shallow drainage depression.
ST15	142.9	On east side of Yazoo River, near Egypt Plantation. Sample taken 20 ft from edge of water in trees between road and river.
ST12	136.0	On north side of Yazoo River, east bank. Samples 12T and 12B taken at top of bank, 15 ft from river in trees along the bank 300 ft south of the levee road. Sample 12F taken 100 ft to the east, in shallow drainage depression at edge of field.
ST11	132.5	On south side of Yazoo River, 0.4 miles upstream of Silent Shade Bridge. Sample taken at edge of a cotton field, 80 ft from edge of water.
ST8	123.0	On north side of Yazoo River and east side of outlet channel from Wasp Lake. Sample taken 15 ft from edge of water and 20 ft downstream of drainage gully outfall.
ST6	111.4	On west side of Yazoo River, in a bend just above the community of Silver City, MS. Sample taken 10 ft from edge of water at the top of the bank.

Table II-22

Pesticide Concentrations in 1990 and 1980 Cores

Station	1980 Pesticides (mg/kg)		1990 Pesticides (mg/kg)	
ST6	PPDDD	1.6	PPDDD	ND*
	PPDDE	0.5	PPDDE	ND
	PPDDT	2.0	PPDDT	ND
ST8	PPDDD	9.8	PPDDD	0.003
	PPDDE	5.8	PPDDE	0.004
	PPDDT	7.9	PPDDT	ND
	CHLORDANE	4.0	CHLORDANE	ND
ST11	PPDDD	ND	PPDDD	ND
	PPDDE	ND	PPDDE	ND
	PPDDT	ND	PPDDT	ND
ST12-T **	PPDDD	0.059	PPDDD	0.0013
	PPDDE	0.071	PPDDE	0.0022
	PPDDT	0.074	PPDDT	ND
	DIELDRIN	0.0006	DIELDRIN	ND
	ENDRIN	0.0004	ENDRIN	ND
ST12-B +	PPDDD	0.0003	PPDDD	0.0037
	PPDDE	0.0001	PPDDE	0.014
	PPDDT	0.0016	PPDDT	ND
ST15	PPDDD	0.0022	PPDDD	ND
	PPDDE	0.0021	PPDDE	0.011
	PPDDT	0.0095	PPDDT	ND
ST17	PPDDD	0.0015	PPDDD	ND
	PPDDE	0.002	PPDDE	0.0039
	PPDDT	0.0036	PPDDT	ND

* ND indicates values less than detection limits.
** This station was designated station 12 in the 1980 study.
\+ This station was designated station 12A in the 1980 study.

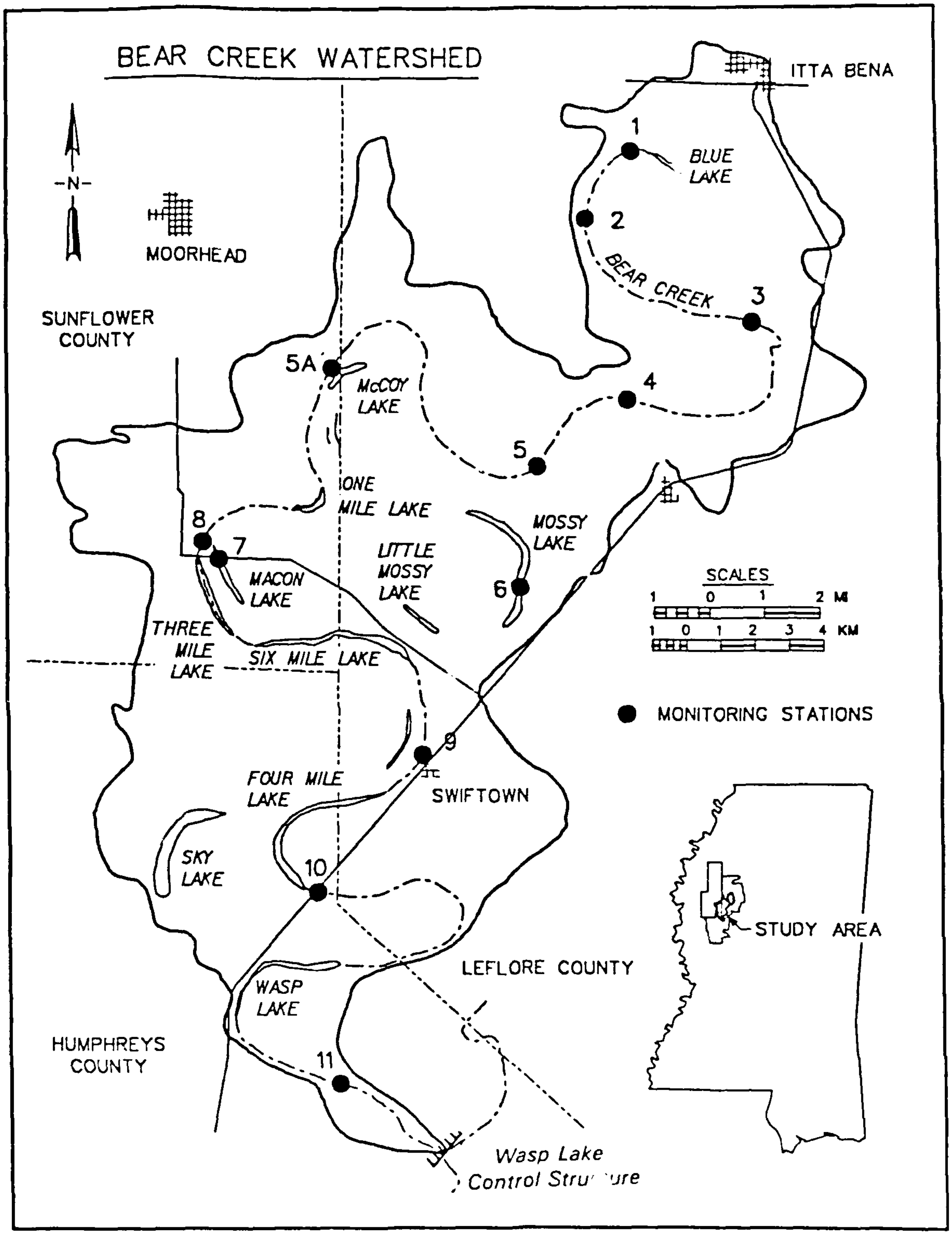

Figure II-1. Bear Creek watershed showing major lakes and sampling stations

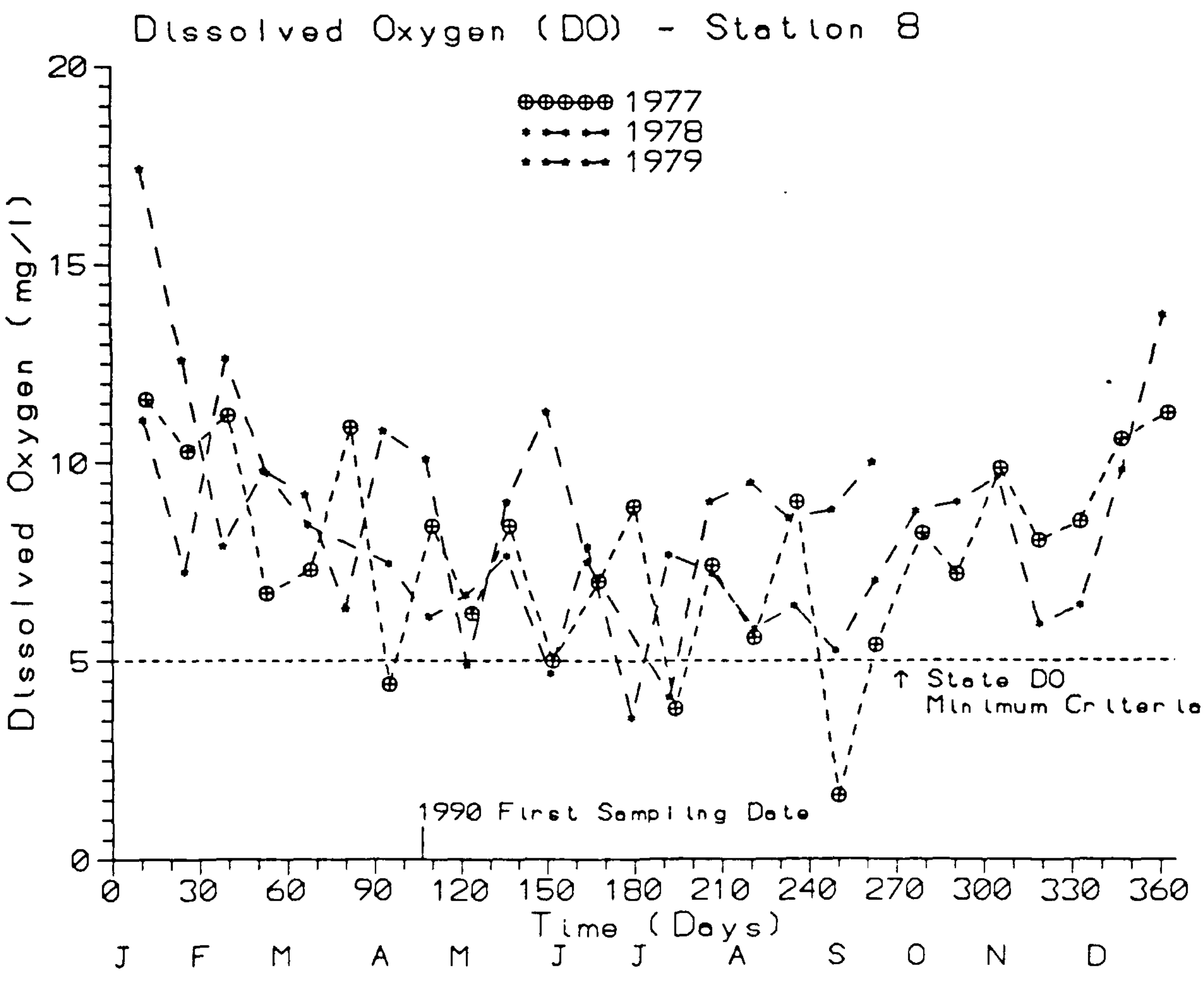

Figure II-2. DO levels in Three Mile Lake (Station 8) during 1977-1979 (USDA 1977a-d, USDA 1978a-d, USDA 1979a-d)

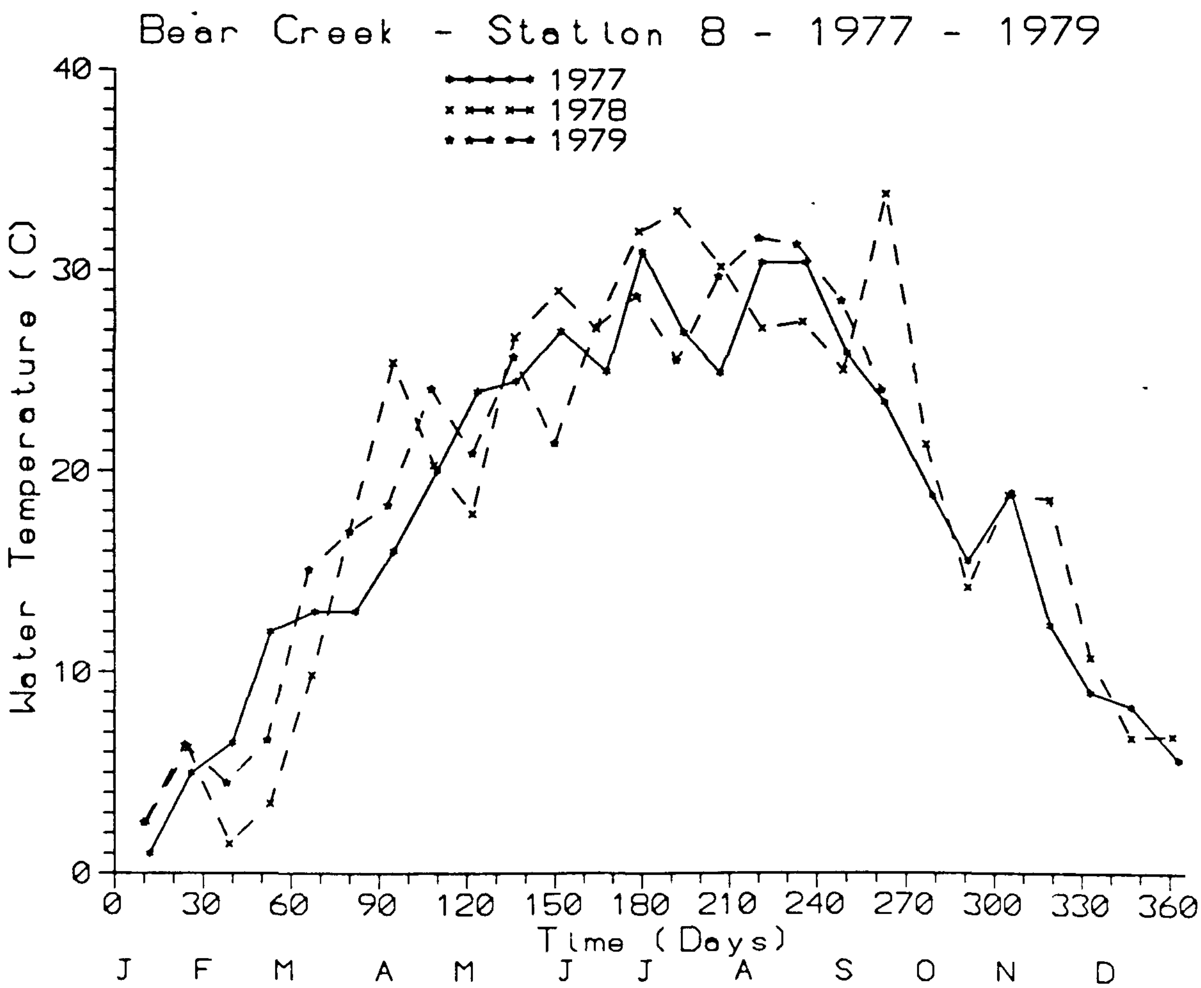

Figure II-3. Temperatures in Three Mile Lake (Station 8) during 1977-1979 (USDA 1977a-d, USDA 1978a-d, USDA 1979a-d)

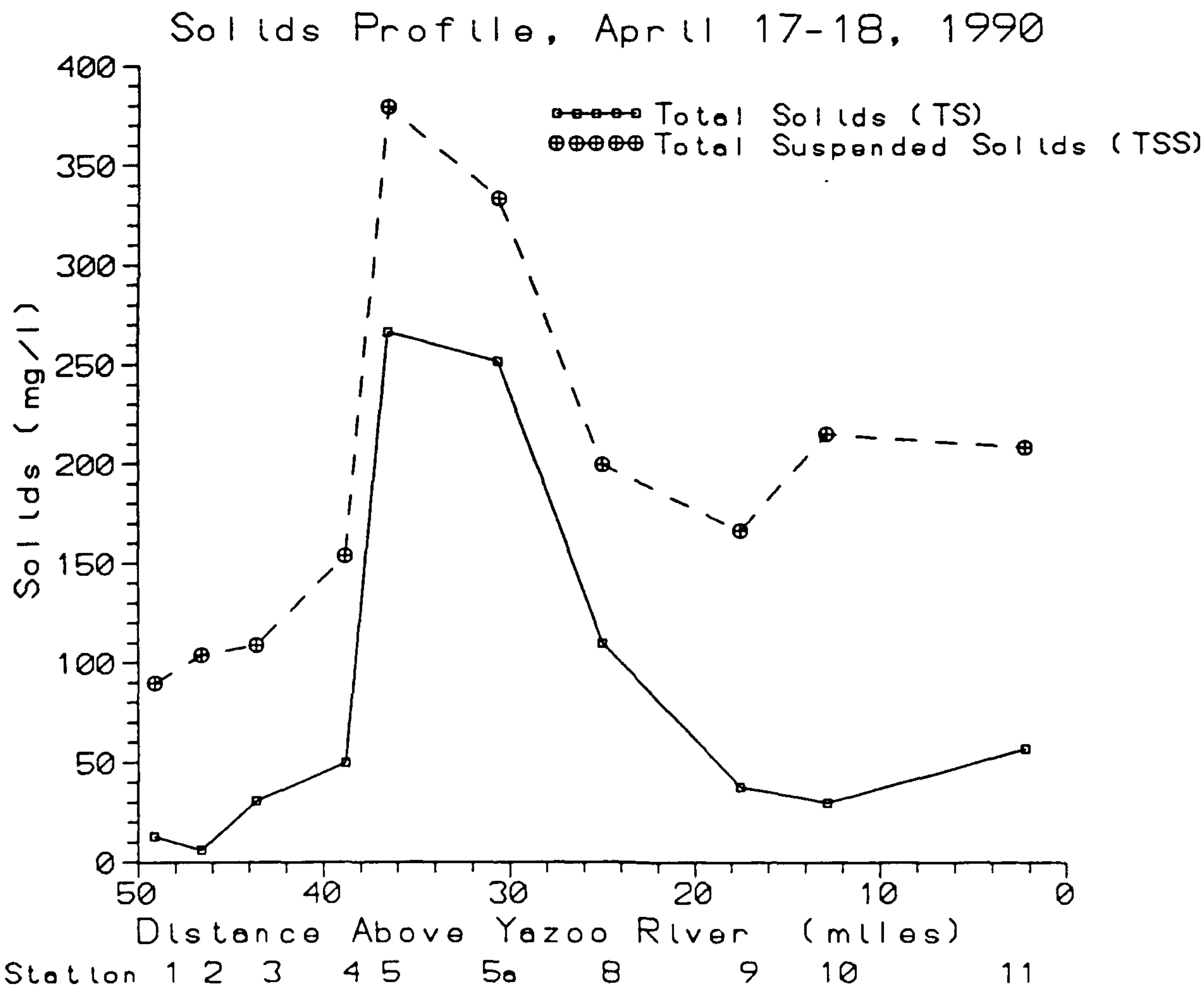

Figure II-4. Total and suspended solids in Bear Creek, April 17-18, 1990.

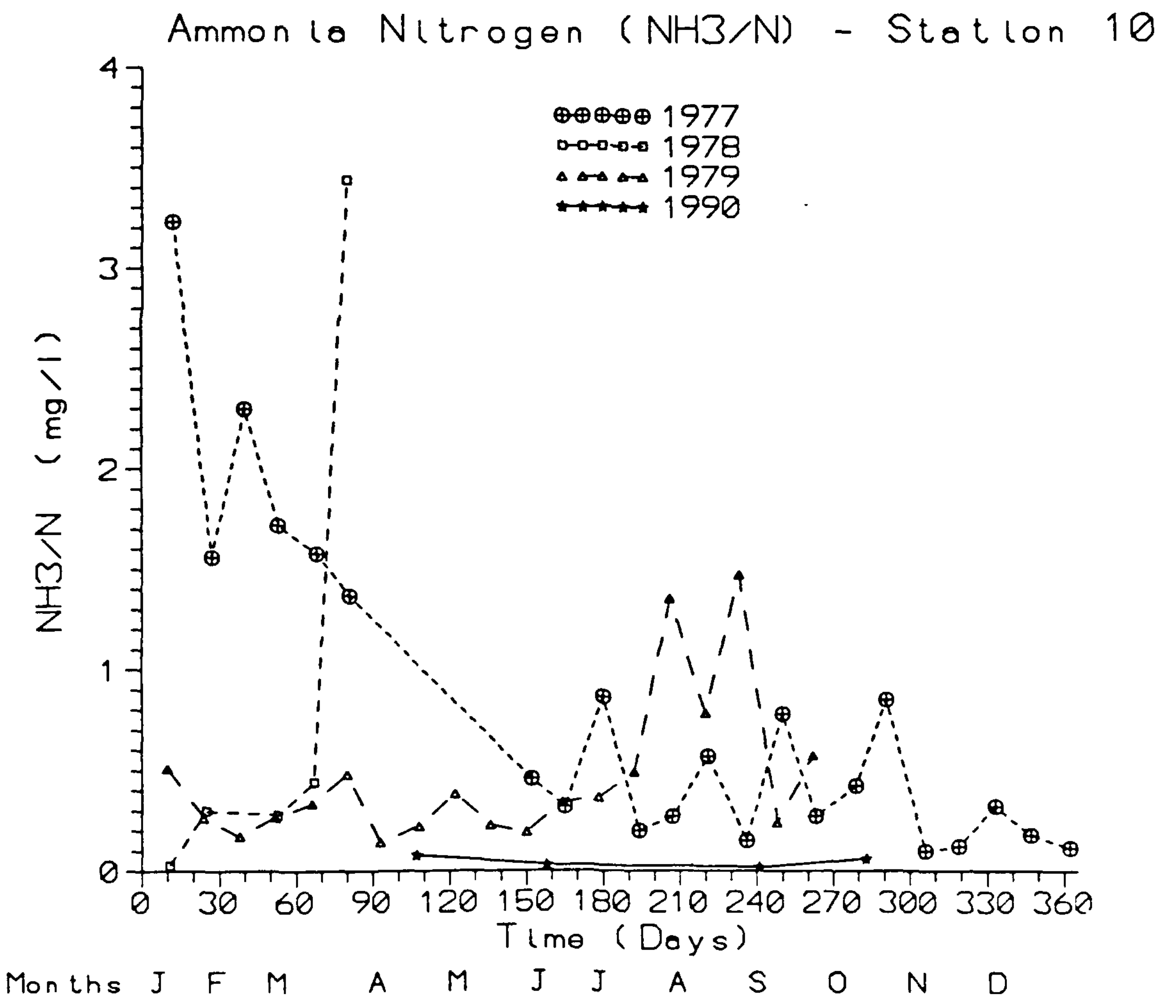

Figure II-5. NH_3-N concentrations at Four Mile Lake (Station 1-) for 1977-1979 and 1990

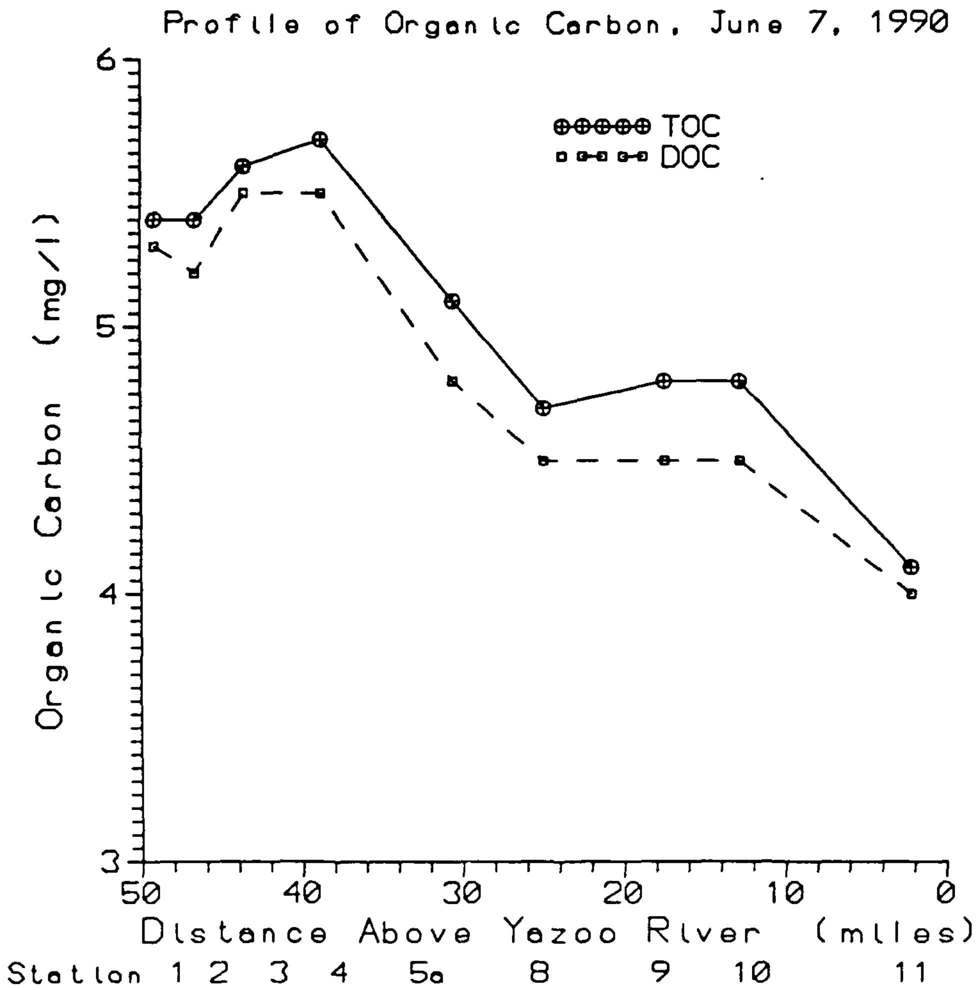

Figure II-6. Organic carbon in the Bear Creek watershed, June 7, 1990

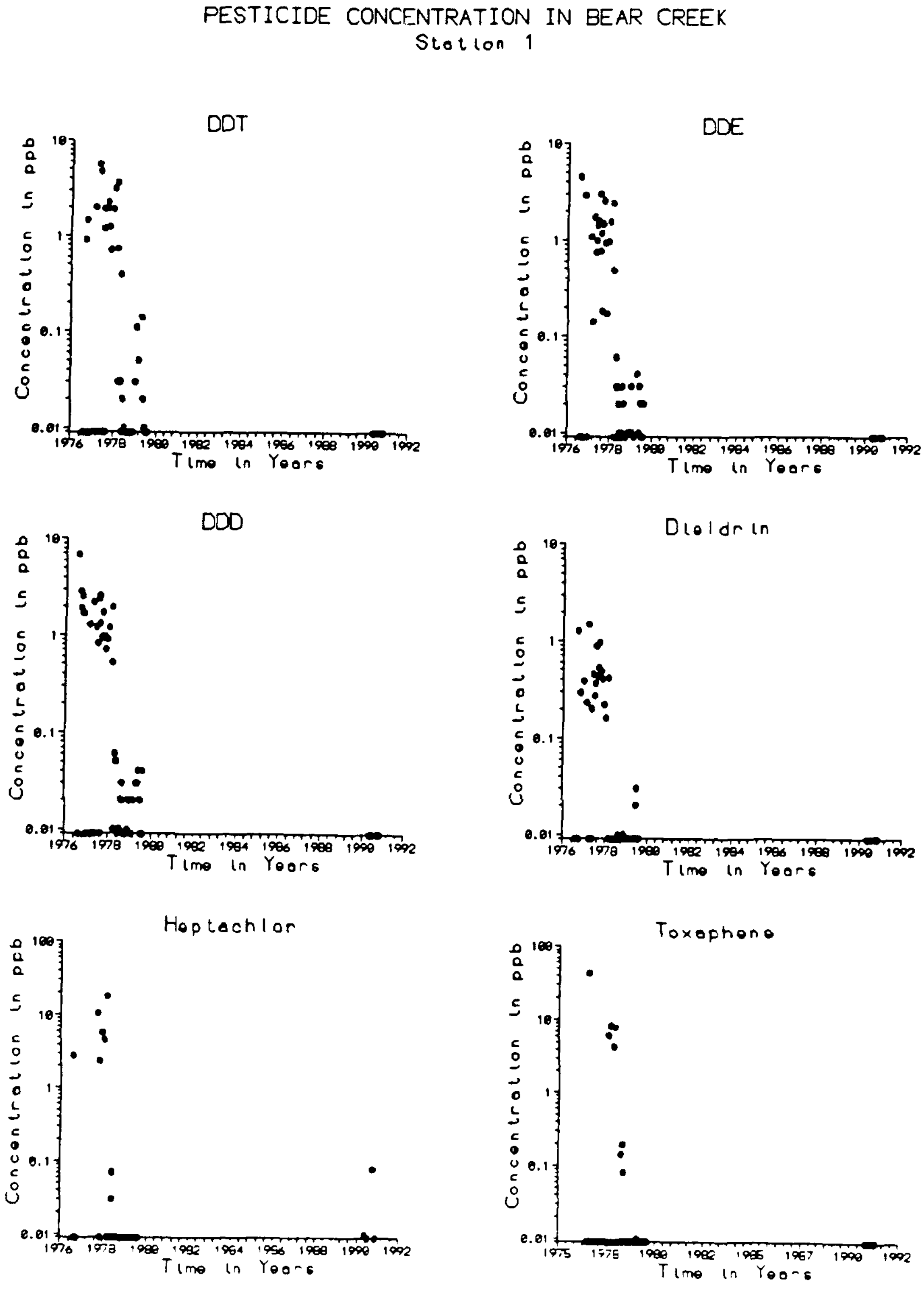

Figure II-7. Temporal distribution of pesticides in water samples taken from Bear Creek at Blue Lake (Station 1), 1976-1979 (USDA 1976 through 1979) and 1990

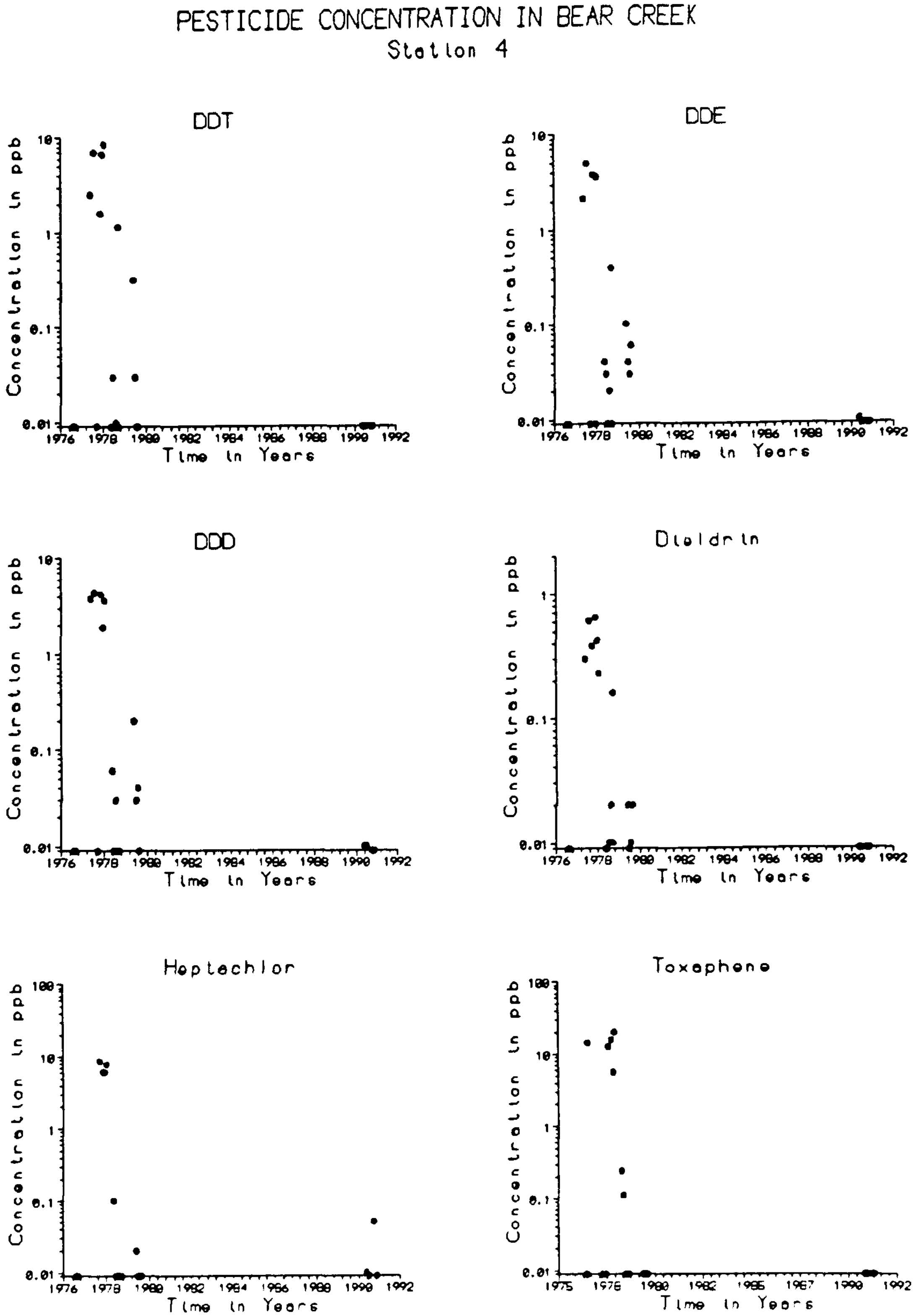

Figure II-8. Temporal distribution of pesticides in water samples taken from Bear Creek near Morgan City (Station 4), 1976-1979 (USDA 1976 through 1979) and 1990

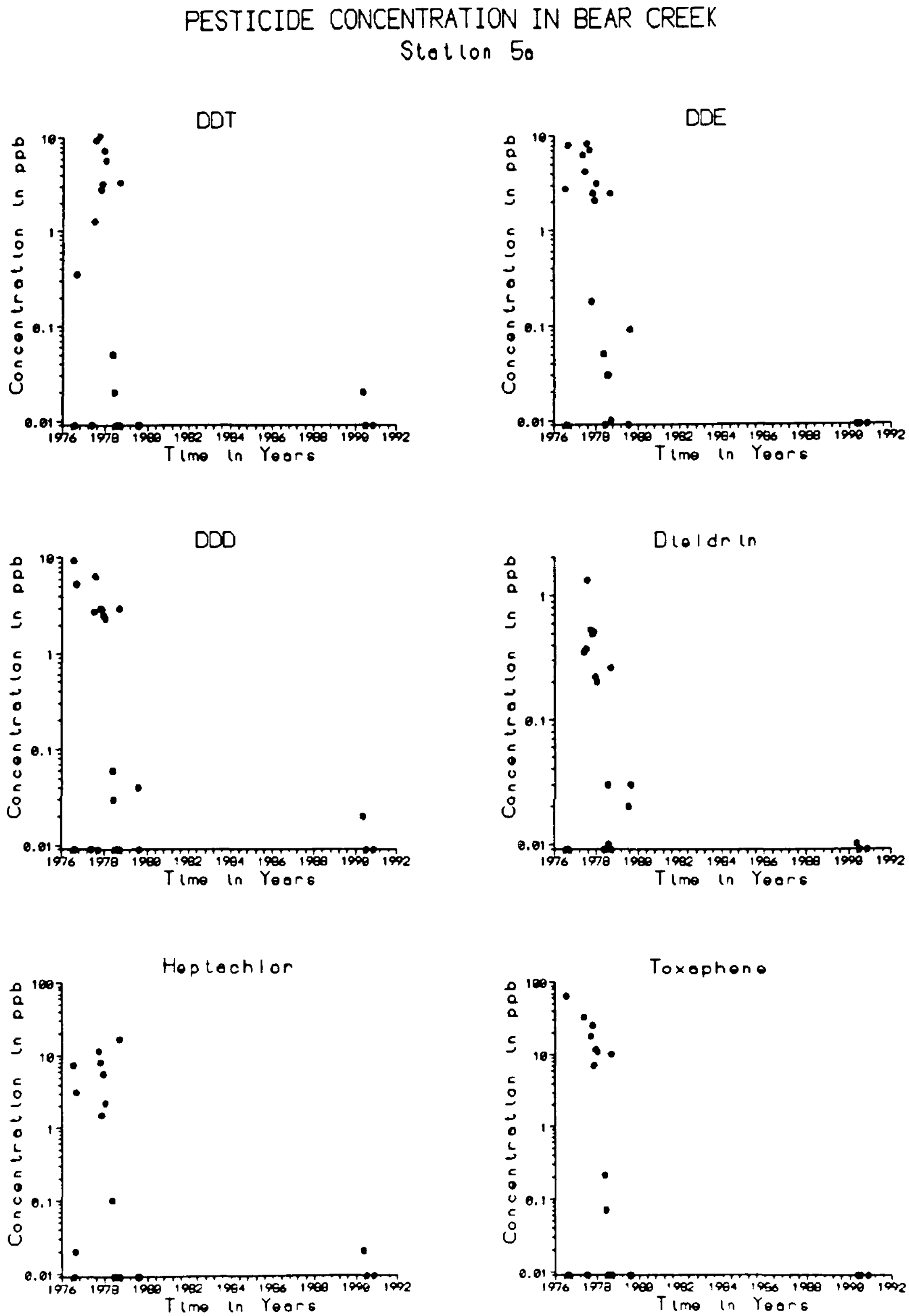

Figure II-9. Temporal distribution of pesticides in water samples taken from Bear Creek near Old Dominion Plantation (Station 5a), 1976-1979 (USDA 1976 through 1979) and 1990

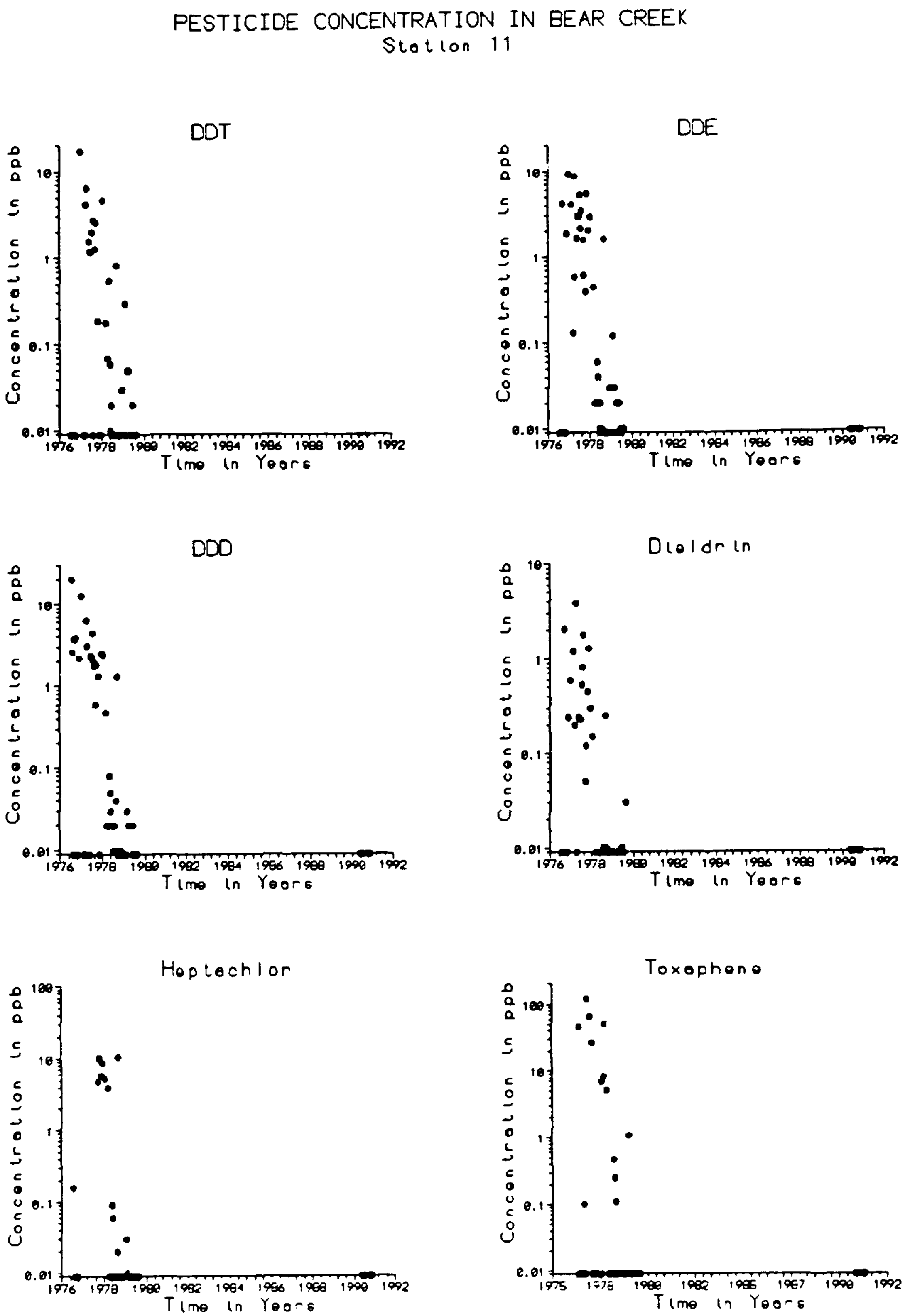

Figure II-10. Temporal distribution of pesticides in water samples taken from Bear Creek at Wasp Lake (Station 11), 1976-1979 (USDA 1976 through 1979) and 1990

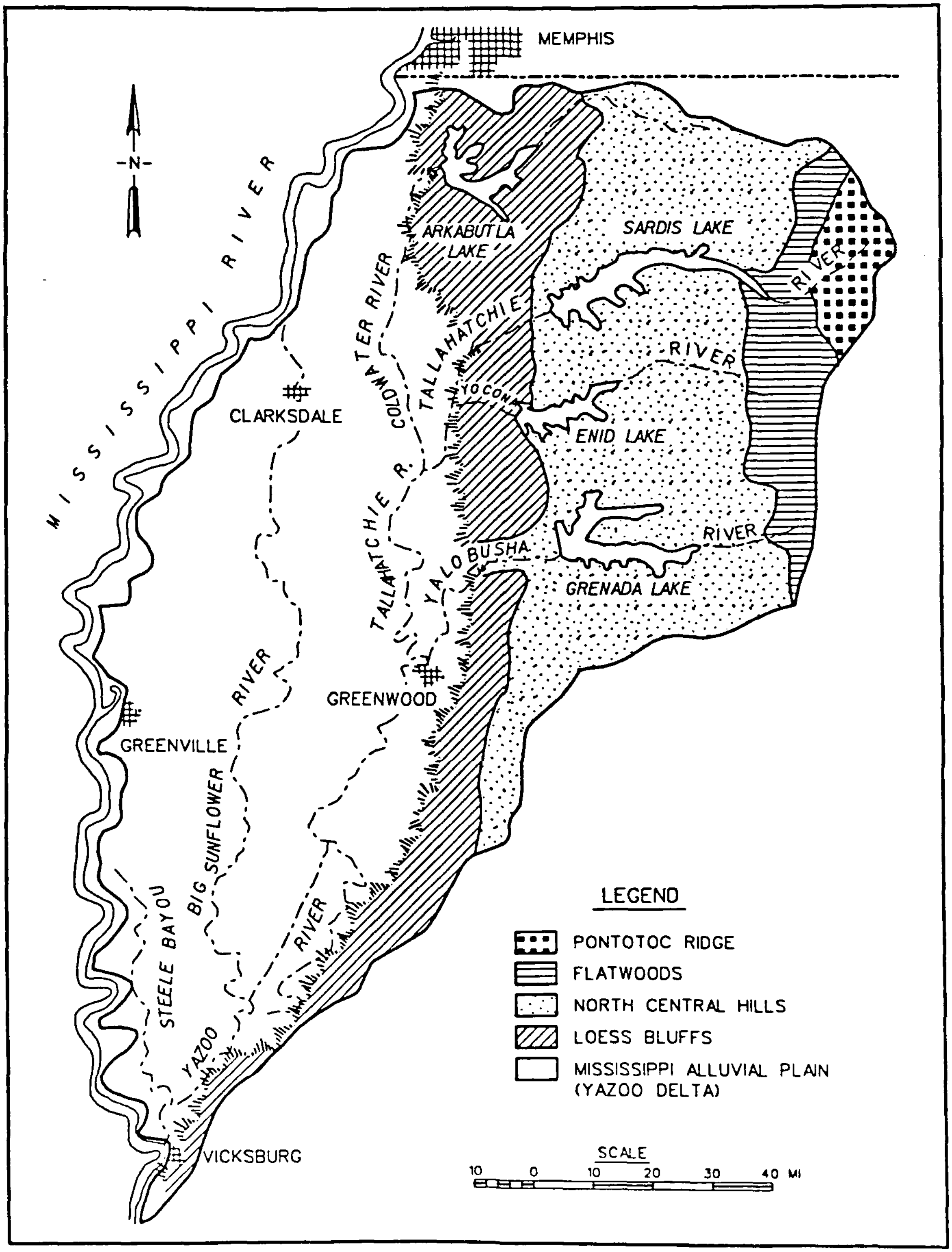

Figure II-11. Yazoo River Basin

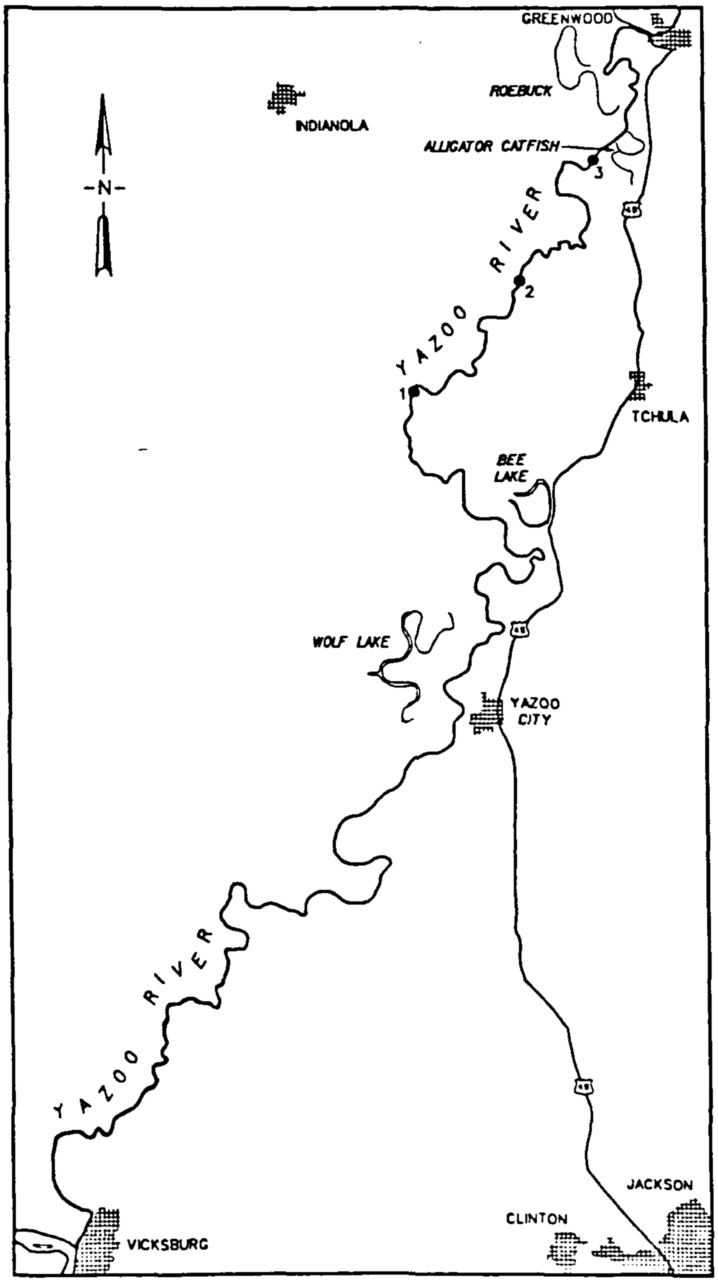

Figure II-12. Yazoo River stations for pesticides and water quality parameters

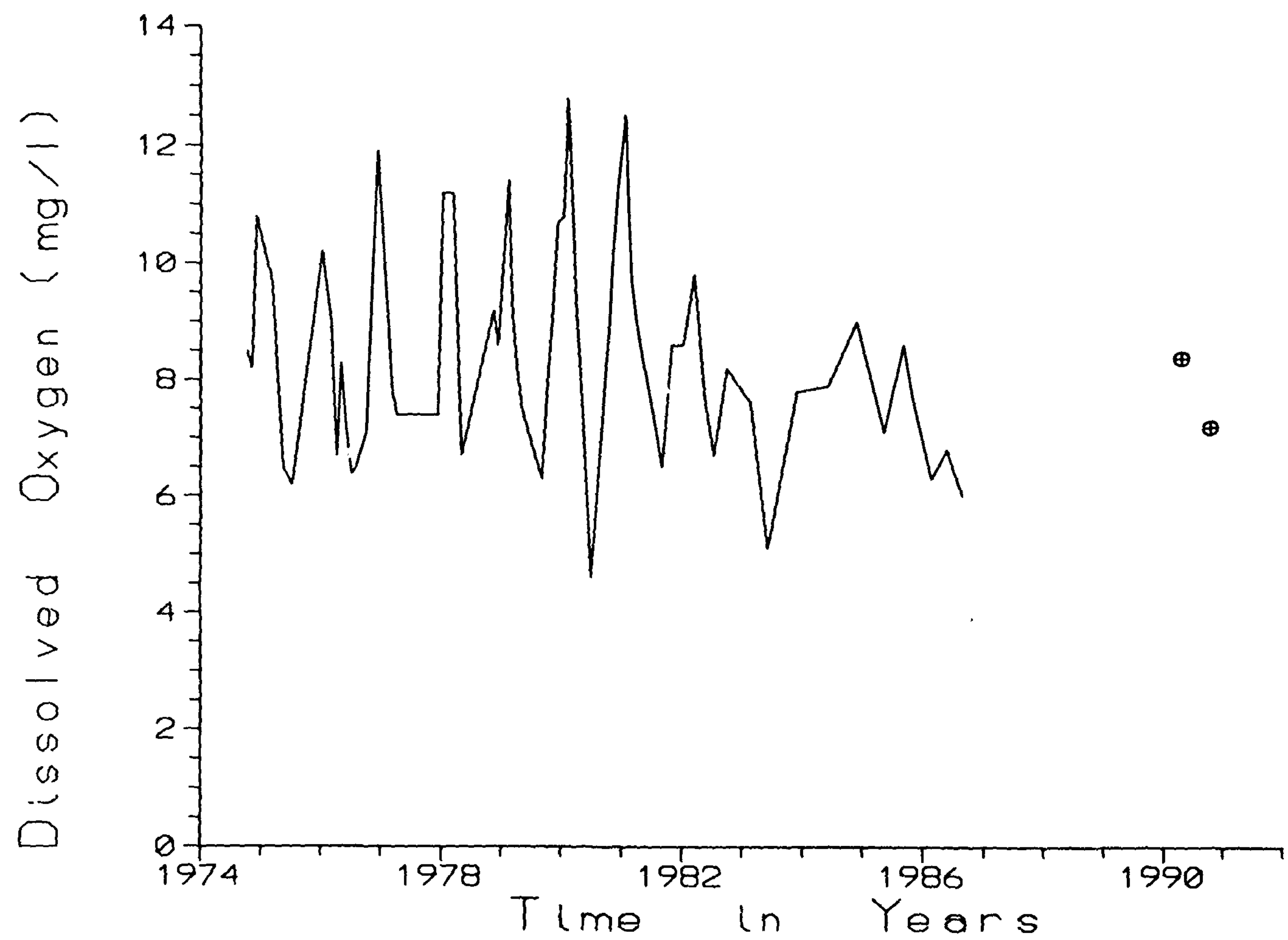

Figure II-13. Dissolved oxygen at Shell Bluff, Yazoo River

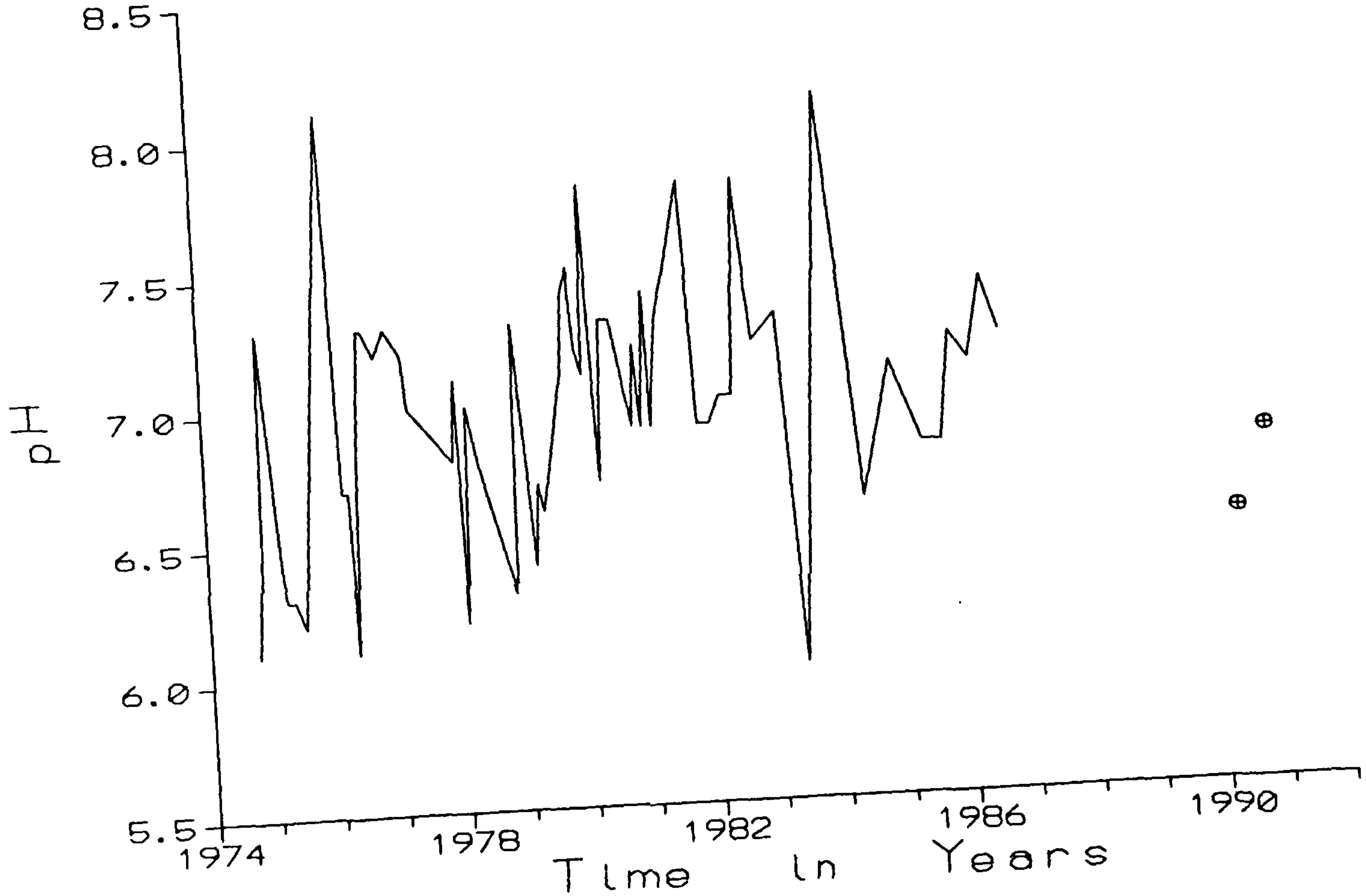

Figure II-14. pH at Shell Bluff, Yazoo River

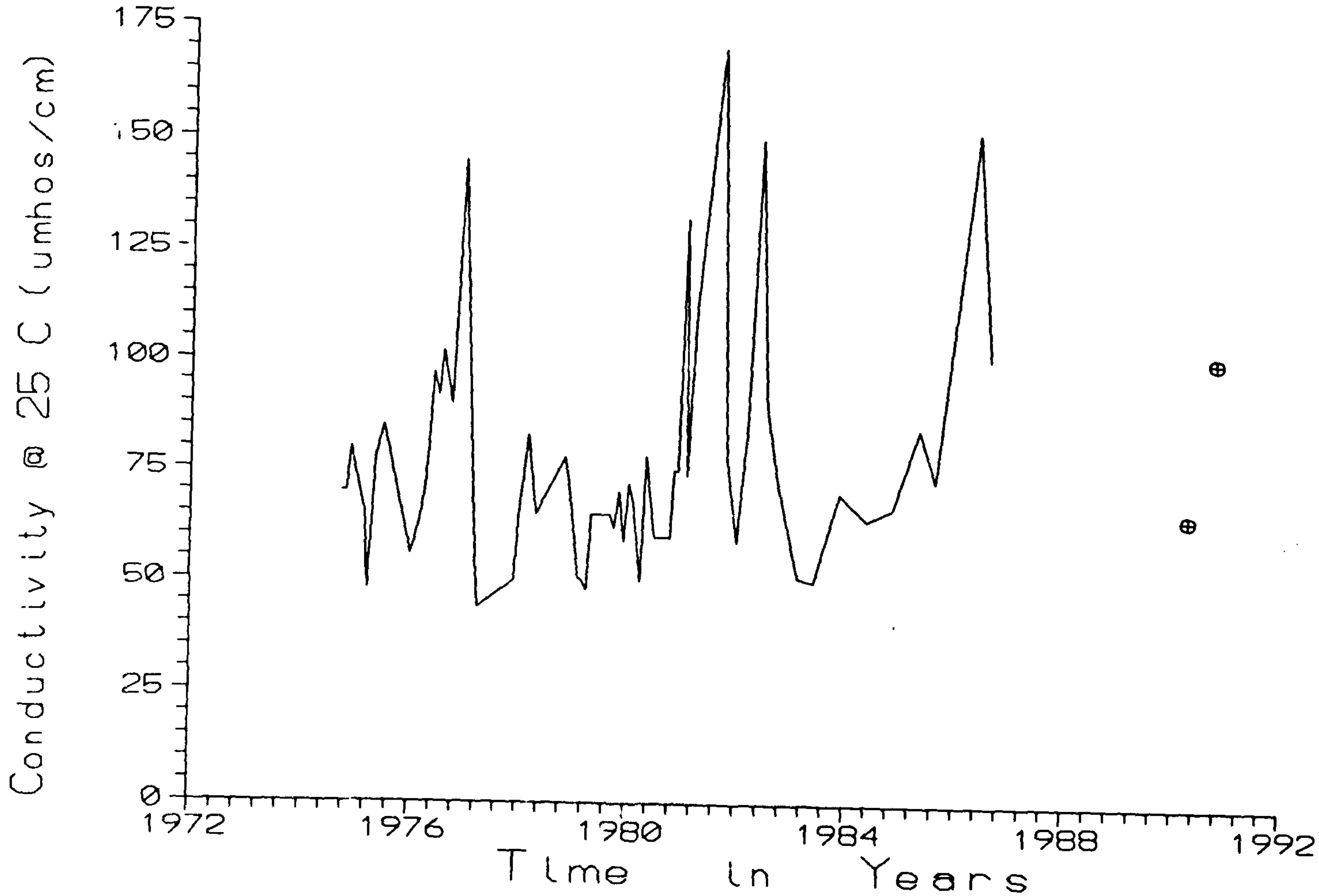

Figure II-15. Conductivity at Shell Bluff, Yazoc River

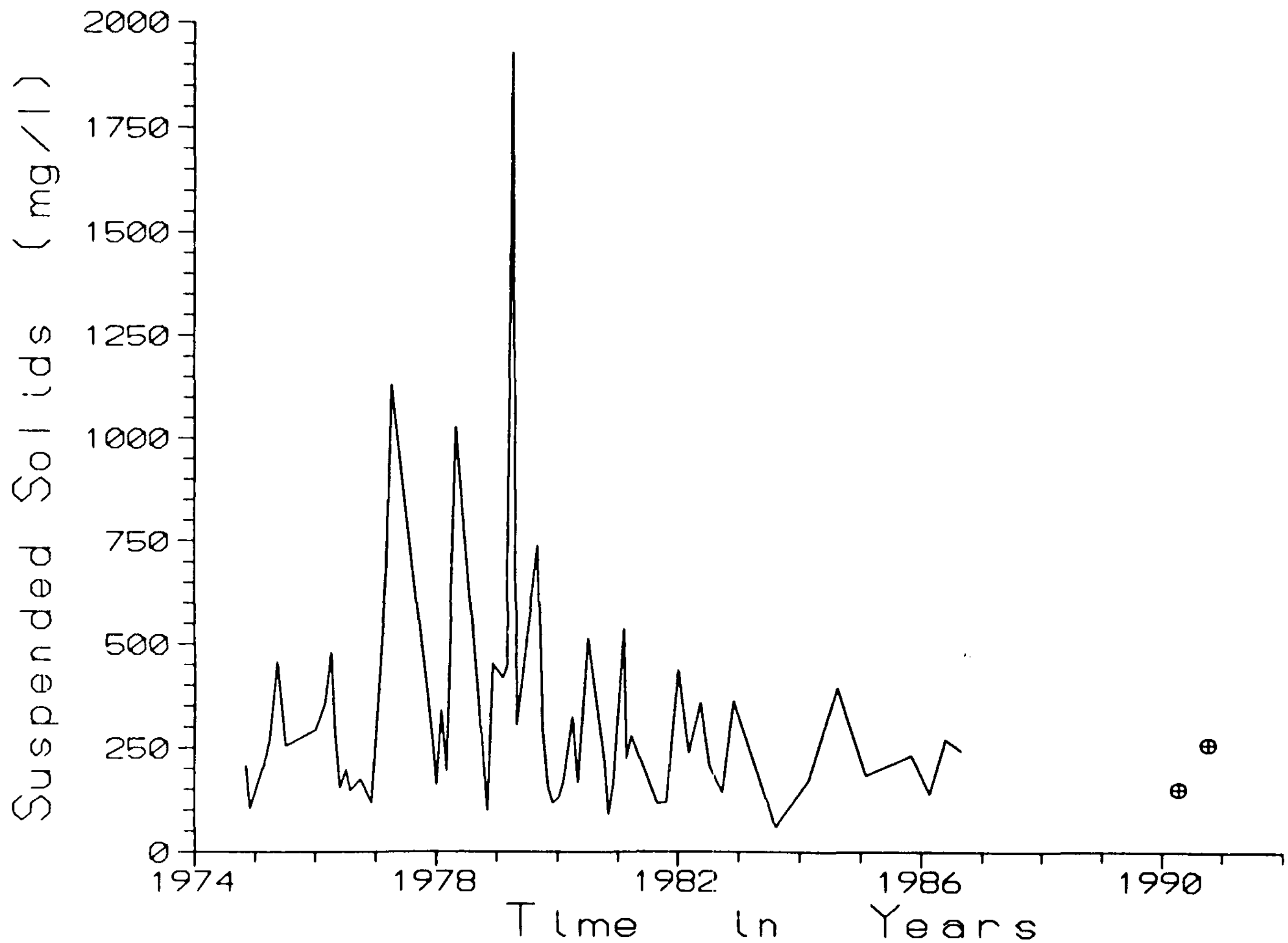

Figure II-16. Suspended solids at Shell Bluff, Yazoo River

PART III: EFFECTS OF CHANNELIZATION ON WATER QUALITY

Comparisons between sediment and water quality data collected within a channelized and unchannelized reach were used to determine differences, if any, between the two reaches. Data were collected to coincide with high-water flow, low-water flow, and agricultural activities. These results will allow the Corps to evaluate the impacts of dragline channelization on water quality. Any channelization method that would produce an identical channel design should have similar long-term impacts on water quality. This study does not distinguish between impacts of channelization and non-point source runoff within the reaches.

Target reaches were identified through consultation with Vicksburg District personnel, sampling locations of historical data, and field reconnaissance. The following criteria were used to evaluate candidate reaches: (1) the present/absence of recent channelization; (2) proximity to agricultural activities; (3) physical characteristics--stream size, depth, curvature, distance downstream from the confluence of tributaries; and (4) minimal obstructions (i.e., bridges, bank failures). Reaches along the Yazoo River received priority over comparable reaches along tributaries.

Selected reaches were along the Yazoo River between river miles 133 and 144. This study focused on a channelized reach (river mile 133.4 through 133.8) and an unchannelized reach (river mile 143.2 through 143.6). The channelized reach is part of the Yazoo River Basin Upper Yazoo Project Item 3A-1 (river miles 131.5 through 135.6). Ronald Adams Contractors, Inc., performed dragline channel improvement between June 1988 and January 1989.* Channelization was approximately 65% complete at the time data were collected (March-November 1990). In addition to recent channelization, the location and physical characteristics of this reach satisfy the criteria presented above. District plans called for dredging north of Item 3A-1. Therefore, an unchannelized reach was selected north of the target dredging zone. The location and physical characteristics of this reach also satisfy the criteria presented above. Historical water quality data are available from these reaches (Bednar and Grantham 1980).

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* Personal Communication, 15 February 1990, Captain Chuck King, Deputy Project Manager, Yazoo Basin, US Army Engineer District, Vicksburg.

Five sampling locations were established in each of the two reaches (channelized reach, YZ08 through YZ12; unchannelized reach, YZ20 through YZ24). The distance between sampling locations was 0.1 mile. Surface sediment and water samples were collected between March and November 1990 (Table III-1). The sediment and water samples were collected by personnel from WES and Vicksburg District, and from the USGS Jackson office, respectively. The sampling procedures and analytical methods are described in Appendix A. Sample analyses included the parameters shown in Tables II-3 and II-4.

Pesticides were rarely detected in surface sediments (Table IV-13). Additionally, traces of 2,4,5-T (0.037 mg/kg) and 2,4-DB (0.056 mg/kg) were detected at stations YZ21 and YZ09. PPDDD, PPDDE, PPDDT, HPTCL, 2,4,5-T, and 2,4-DB were the only pesticides detected. PPDDT and 2,4,5-T were detected only in the unchannelized reach. PPDDD, PPDDE, HPTCL, and 2,4-DB were detected only in the channelized reach. All sediment samples were more than 90 percent sand (Table IV-16). Since contaminants are usually adsorbed to fine-grained material, low pesticide concentrations were anticipated (Lee, Engler, and Mahloch 1976). These surface sediments make minimal contribution to pesticide concentrations in the water column.

Table III-2 contains water analyses results from five sampling events. PPDDT, HPTCL, ENDOI, ENDRIN, and TRIFLURA were the only pesticides detected. ENDRIN was detected only in the channelized reach. TRIFLURA was detected only in the unchannelized reach. PPDDT and ENDOI were detected only once in both reaches. HPTCL was detected several times in both reaches. The detection or nondetection of these pesticides does not correlate with sampling location (i.e., river reach).

In 1979, pesticides detected in the channelized reach water samples included PPDDD, PPDDT, DIELDRIN, DIAZINON, 2,4-D, and 2,4,5-T. Pesticides detected in the unchannelized reach water samples included 2,4-D and 2,4,5-T (Table III-3). Several of the pesticides present in 1979 were not detected in this study (i.e. PPDDD, DIELDRIN, DIAZINON, 2,4-D, and 2,4,5-T). Some of the 1990 levels of PPDDT, HPTCL, and ENDRIN concentrations were higher than the 1979 levels. Some of the 1990 levels of ENDOI were slightly higher than the total ENDOSULFAN levels recorded in 1979 (Bednar and Grantham 1980).

Numerical comparisons between concentrations in channelized and unchannelized reaches were accomplished with a statistical comparison involving two means (Steel and Torrie 1980). This test compares the mean concentration from five stations in the channelized reach to the mean concentration from five stations in the unchannelized reach. Separate tests were run for each sampling event. The null hypothesis was that mean concentrations from the channelized reach equaled mean concentrations from the unchannelized reach (i.e., the assumption was that mean concentrations from the respective reaches were equal). If the data indicated that this assumption was false, the null hypothesis was rejected. Failure to reject the null hypothesis would lead one to conclude that the parameter was not affected by channelization. Rejecting the null hypothesis leads one to conclude that mean concentrations from the respective reaches are statistically different. However, statistical difference is not conclusive evidence that channelization has impacted a parameter. Parameters could also be impacted by non-point source runoff within the reaches. All tests were conducted using alpha = 0.05.

The temperature, DO, conductivity, and pH values were virtually the same in both reaches (Tables III-4 through III-8). Other parameters are shown in Figures III-1 through III-10. The northernmost location in each reach was assigned the distance 0.0 (i.e. Station YZ08 in the channelized reach and Station YZ20 in the unchannelized reach) for the purpose of plotting the graphs. These figures show parameter fluctuation within the respective reaches. In many cases, the fluctuation within a reach exceeded the maximum difference between reaches (e.g. TDP, May 29, 1990; turbidity and TSS, July 26, 1990; ON, September 10, 1990). In May, TOC and DOC concentrations in the channelized reach were statistically higher than concentrations in the unchannelized reach. The NO_3/NO_2-N concentrations were statistically lower in the channelized than in the unchannelized reach. In November, turbidity, total solids, and total suspended solids concentrations in the channelized reach were statistically higher than concentrations in the unchannelized reach. The null hypothesis was not rejected in the 43 remaining tests. These data indicated that channelization had negligible impact on the physical, nutrient, and pesticide parameters measured in this study.

Table III-1

Yazoo River Sediment and Water Quality Sampling Schedule

Sample Type	Sampling Dates
Water	March 21-22, 1990 May 29, 1990 July 26, 1990 September 10, 1990 November 1, 1990
Sediment	May 14-16, 1990

Table III-2

Yazoo River Pesticide Data from Water Samples

Station	River Mile	Date	PPDDT (mg/l)	HPTCL (mg/l)	ENDOI (mg/l)	ENDRIN (mg/l)	TRIFLURA (mg/l)
Unchannelized							
YZ24	143.2	Mar.	<0.00001	0.00001	<0.00001	<0.00001	<0.00001
Unchannelized							
YZ21	143.5	May	0.00003	<0.00001	<0.00001	<0.00001	0.00002
Channelized							
YZ12	133.4	July	<0.00001	0.00005	<0.00001	<0.00001	<0.00001
YZ11	133.5	July	<0.00001	0.00001	<0.00001	<0.00001	<0.00001
YZ10	133.6	July	<0.00001	<0.00001	<0.00001	0.00006	<0.00001
YZ09	133.7	July	<0.00001	0.00007	<0.00001	0.00001	<0.00001
YZ08	133.8	July	<0.00001	0.00001	<0.00001	<0.00001	<0.00001
Unchannelized							
YZ24	143.2	July	<0.00001	0.00001	<0.00001	<0.00001	<0.00001
YZ23	143.3	July	<0.00001	0.00001	<0.00001	<0.00001	<0.00001
YZ21	143.5	July	<0.00001	0.00001	<0.00001	<0.00001	<0.00001
Channelized							
YZ11	133.5	Sep.	0.00002	<0.00001	<0.00001	<0.00001	<0.00001
YZ09	133.7	Sep.	<0.00001	<0.00001	0.00001	<0.00001	<0.00001
Unchannelized							
YZ24	143.2	Sep.	<0.00001	0.00001	<0.00001	<0.00001	<0.00001
YZ21	143.5	Sep.	<0.00001	0.00001	0.00001	<0.00001	<0.00001
Channelized							
YZ08	133.8	Nov.	<0.00001	0.00005*	<0.00001	<0.00001	<0.00005

* HPTCL was detected in the sample blank for this sampling period (i.e. 0.00002 mg/l). The detection of HPTCL in the blank decreases the confidence in this sample result.

Table III-3

Yazoo River Water Quality Data, December 3-6, 1979*

Station**	River Mile	Temp (°C)	DO (mg/l)	Cond (µmhos/cm)	pH
11	133.6	8.5	10.5	57	6.8
14	143.0	9.0	10.2	60	6.8

Station	NO_3/NO_2-N (mg/l)	NH_3-N (mg/l)	TP (mg/l)	TDP (mg/l)	ENDOSULFAN+ (ug/l)
11	0.21	0.05	0.12	0.04	<0.01
14	0.26	0.20	0.22	0.03	<0.01

Station	ALDRIN (ug/l)	PPDDD (ug/l)	PPDDE (ug/l)	PPDDT (ug/l)	HPTCL+ (ug/l)	HPTCLE (ug/l)	DIELDRIN (ug/l)
11	0.0	0.002	0.0	0.003	<0.01	0.0	0.003
14	0.0	0.000	0.0	0.CC0	<0.01	0.0	0.000

Station	ENDRIN+ (ug/l)	CHLORDANE (ug/l)	TOXAPHEN (ug/l)	DIAZINON (ug/l)	ETPATH (ug/l)	ETTRITH (ug/l)	ETHION (ug/l)
11	<0.01	0.0	0.0	0.04	0.0	0.0	0.0
14	<0.01	0.0	0.0	0.00	0.0	0.0	0.0

Station	MALATH (ug/l)	METPATH (ug/l)	2,4-D (ug/l)	2,4-DP (ug/l)	2,4,5-T (ug/l)	METOXYCL (ug/l)	PCBs (ug/l)
11	0.0	0.0	0.03	0.0	0.01	0.0	0.0
14	0.0	0.0	0.03	0.0	0.01	0.0	0.0

* Data from US Geological Survey (Bednar and Grantham 1980).

** Only stations within the channelized and unchannelized reaches of the present study (1990) are presented. Other locations were sampled by Bednar and Grantham (See Table 1). Station 11 was in the channelized reach; Station 14 is very near the unchannelized reach.

\+ The detection limit used in these analyses was 0.01 ug/l. Personal Communication, 6 March 1991, Mr. Paul Grantham, USGS Jackson office.

Table III-4

Yazoo River Water Quality Data, March 21-22, 1990

Station	River Mile	Temp (°C)	DO (mg/l)	Cond (µmhos/cm)	pH	Turb (NTU)	TS (mg/l)	TSS (mg/l)
Channelized								
YZ12	133.4	14.5	8.5	51	6.8	97	193	88
YZ11	133.5	14.5	8.5	52	6.8	100	182	70
YZ10	133.6	14.5	8.5	52	6.8	96	194	81
YZ09	133.7	14.5	8.5	52	6.8	98	205	90
YZ08	133.8	14.5	8.5	51	6.8	95	185	63
Unchannelized								
YZ24	143.2	14.5	8.5	51	6.8	96	184	73
YZ23	143.3	14.5	8.5	52	6.8	96	202	78
YZ22	143.4	14.5	8.5	51	6.8	95	207	78
YZ21	143.5	14.5	8.5	52	6.8	95	192	81
YZ20	143.6	14.5	8.5	51	6.8	100	193	80

Station	NO_3/NO_2-N (mg/l)	NH_3-N (mg/l)	ON (mg/l)	TP (mg/l)	TDP (mg/l)	TOC (mg/l)	DOC (mg/l)
Channelized							
YZ12	0.32	0.05	0.85	0.21	0.02	3.9	3.9
YZ11	0.34	0.05	0.86	0.24	0.04	4.0	4.0
YZ10	0.32	0.05	0.83	0.21	0.03	3.9	3.9
YZ09	0.39	0.04	0.85	0.21	0.04	4.7	4.7
YZ08	0.32	0.04	0.79	0.20	0.02	4.6	4.4
Unchannelized							
YZ24	0.35	0.05	0.63	0.20	0.02	4.3	4.2
YZ23	0.36	0.04	0.70	0.20	0.04	4.5	4.5
YZ22	0.29	0.04	0.90	0.21	<0.02	4.7	4.6
YZ21	0.34	0.04	0.73	0.21	0.05	4.6	4.4
YZ20	0.36	0.04	0.77	0.21	0.04	4.6	4.6

Table III-5

Yazoo River Water Quality Data, May 29, 1990

Station	River Mile	Temp (°C)	DO (mg/l)	Cond (µmhos/cm)	pH	Turb (NTU)	TS (mg/l)	TSS (mg/l)
Channelized								
YZ12	133.4	24.0	5.0	62	6.3	--*	516	384
YZ11	133.5	24.0	5.0	62	6.3	--	523	326
YZ10	133.6	24.0	5.0	62	6.3	--	532	288
YZ09	133.7	24.0	5.1	62	6.3	--	600	452
YZ08	133.8	24.0	5.0	62	6.3	--	451	320
Unchannelized								
YZ24	143.2	24.0	5.0	62	6.3	--	528	382
YZ23	143.3	24.0	5.1	62	6.3	--	474	370
YZ22	143.4	24.0	5.0	62	6.3	--	593	446
YZ21	143.5	24.0	5.0	62	6.3	--	523	392
YZ20	143.6	24.0	5.0	62	6.3	--	458	324

Station	NO_3/NO_2-N (mg/l)	NH_3-N (mg/l)	ON (mg/l)	TP (mg/l)	TDP (mg/l)	TOC (mg/l)	DOC (mg/l)
Channelized							
YZ12	0.48	0.07	2.0	0.54	0.03	4.2	3.9
YZ11	0.51	0.07	1.4	0.51	0.06	4.3	3.9
YZ10	0.51	0.06	1.6	0.58	0.07	4.3	3.8
YZ09	0.50	0.07	1.6	0.68	0.10	4.3	4.0
YZ08	0.53	0.07	1.4	0.56	0.10	3.8	3.8
Unchannelized							
YZ24	0.56	0.07	1.4	0.58	0.06	3.7	3.7
YZ23	0.52	0.07	1.4	0.48	0.07	3.8	3.6
YZ22	0.54	0.08	1.4	0.50	0.06	3.6	3.3
YZ21	0.54	0.07	1.4	0.50	0.06	3.7	3.5
YZ20	0.54	0.07	1.5	0.44	0.06	3.4	2.8

* Equipment failure precluded data collection during this sampling event.

Table III-6

Yazoo River Water Quality Data, July 26, 1990

Station	River Mile	Temp (°C)	DO (mg/l)	Cond (μmhos/cm)	pH	Turb (NTU)	TS (mg/l)	TSS (mg/l)
Channelized								
YZ12	133.4	28.5	5.8	80	6.8	125	205	112
YZ11	133.5	28.5	5.8	80	6.8	90	667	592
YZ10	133.6	28.5	5.8	80	6.8	120	300	198
YZ09	133.7	28.5	5.8	80	6.8	125	370	272
YZ08	133.8	28.5	5.8	80	6.8	110	280	190
Unchannelized								
YZ24	143.2	28.5	5.8	80	6.8	110	279	180
YZ23	143.3	28.5	5.8	80	6.8	120	336	238
YZ22	143.4	28.5	5.8	80	6.8	95	257	160
YZ21	143.5	28.5	5.8	80	6.8	110	341	246
YZ20	143.6	28.5	5.8	80	6.8	125	245	238

Station	NO_3/NO_2-N (mg/l)	NH_3-N (mg/l)	ON (mg/l)	TP (mg/l)	TDP (mg/l)	TOC (mg/l)	DOC (mg/l)
Channelized							
YZ12	0.31	0.03	0.71	0.20	<0.02	3.2	3.1
YZ11	0.30	0.04	0.86	0.26	<0.02	3.1	2.9
YZ10	0.30	0.04	0.76	0.20	0.01	3.2	2.9
YZ09	0.26	0.03	0.80	0.26	0.02	3.0	3.0
YZ08	0.27	0.03	0.78	0.20	0.02	3.1	3.0
Unchannelized							
YZ24	0.37	0.04	0.77	0.18	0.03	3.2	3.1
YZ23	0.29	0.04	0.68	0.21	0.01	3.3	3.1
YZ22	0.29	0.04	0.69	0.17	0.02	3.1	3.0
YZ21	0.30	0.04	0.94	0.22	0.03	2.0	1.4
YZ20	0.35	0.04	1.30	0.20	0.05	1.8	1.1

Table III-7

Yazoo River water Quality Data, September 10, 1990

Station	River Mile	Temp (°C)	DO (mg/l)	Cond (µmhos/cm)	pH	Turb (NTU)	TS (mg/l)	TSS (mg/l)
Channelized								
YZ12	133.4	29.0	6.0	83	7.0	68	469	374
YZ11	133.5	29.0	6.0	83	7.0	55	215	148
YZ10	133.6	29.0	6.0	83	7.0	72	311	242
YZ09	133.7	29.0	6.0	83	7.0	72	273	202
YZ08	133.8	29.0	6.0	83	7.0	70	259	188
Unchannelized								
YZ24	143.2	29.0	6.0	83	7.0	63	259	190
YZ23	143.3	29.0	6.0	83	7.0	66	285	216
YZ22	143.4	29.0	6.0	83	7.0	57	269	158
YZ21	143.5	29.0	6.0	83	7.0	55	226	130
YZ20	143.6	29.0	6.0	83	7.0	62	250	244

Station	NO_3/NO_2-N (mg/l)	NH_3-N (mg/l)	ON (mg/l)	TP (mg/l)	TDP (mg/l)	TOC (mg/l)	DOC (mg/l)
Channelized							
YZ12	0.15	0.02	0.76	0.14	0.05	3.4	3.4
YZ11	0.15	0.02	0.68	0.11	0.05	3.3	3.3
YZ10	0.13	0.01	0.61	0.17	0.04	3.3	3.3
YZ09	0.14	0.02	0.63	0.19	0.05	3.3	3.3
YZ08	0.15	0.02	0.69	0.14	0.05	3.4	3.4
Unchannelized							
YZ24	0.15	0.03	0.59	0.14	0.05	3.4	3.4
YZ23	0.13	0.02	0.50	0.16	0.05	3.3	3.3
YZ22	0.15	0.03	0.87	0.15	0.05	3.3	3.2
YZ21	0.13	0.03	0.93	0.14	0.05	3.1	2.5
YZ20	0.14	0.02	0.43	0.15	0.06	1.9	1.4

Table III-8

Yazoo River Water Quality Data, November 1, 1990

Station	River Mile	Temp (°C)	DO (mg/l)	Cond (µmhos/cm)	pH	Turb (NTU)	TS (mg/l)	TSS (mg/l)
Channelized								
YZ12	133.4	16.5	8.8	69	--*	60	215	154
YZ11	133.5	16.5	8.8	69	--	60	216	150
YZ10	133.6	16.5	8.8	69	--	66	224	164
YZ09	133.7	16.5	8.8	69	--	64	232	154
YZ08	133.8	16.5	8.8	69	--	48	232	182
Unchannelized								
YZ24	143.2	16.5	8.8	69	--	41	152	88
YZ23	143.3	16.5	8.8	69	--	40	181	120
YZ22	143.4	16.5	8.8	69	--	45	194	132
YZ21	143.5	16.5	8.8	69	--	45	210	136
YZ20	143.6	16.5	8.8	69	--	33	187	122

Station	NO_3/NO_2-N (mg/l)	NH_3-N (mg/l)	ON (mg/l)	TP (mg/l)	TDP (mg/l)	TOC (mg/l)	DOC (mg/l)
Channelized							
YZ12	0.12	0.02	0.49	0.13	0.04	2.4	1.0
YZ11	0.12	0.02	0.68	0.13	0.04	2.8	2.5
YZ10	0.12	0.01	0.49	0.14	0.05	4.1	2.4
YZ09	0.12	0.02	0.51	0.13	0.04	2.9	2.7
YZ08	0.11	0.02	0.50	0.14	0.03	2.6	2.6
Unchannelized							
YZ24	0.11	0.02	0.50	0.11	0.04	2.8	2.6
YZ23	0.11	0.02	0.45	0.10	0.04	2.6	2.2
YZ22	0.11	0.02	0.56	0.11	0.05	2.3	2.2
YZ21	0.11	0.02	0.61	0.12	0.04	2.4	1.7
YZ20	0.12	0.02	0.52	0.12	0.06	1.8	1.8

* Equipment failure precluded data collection during this sampling event.

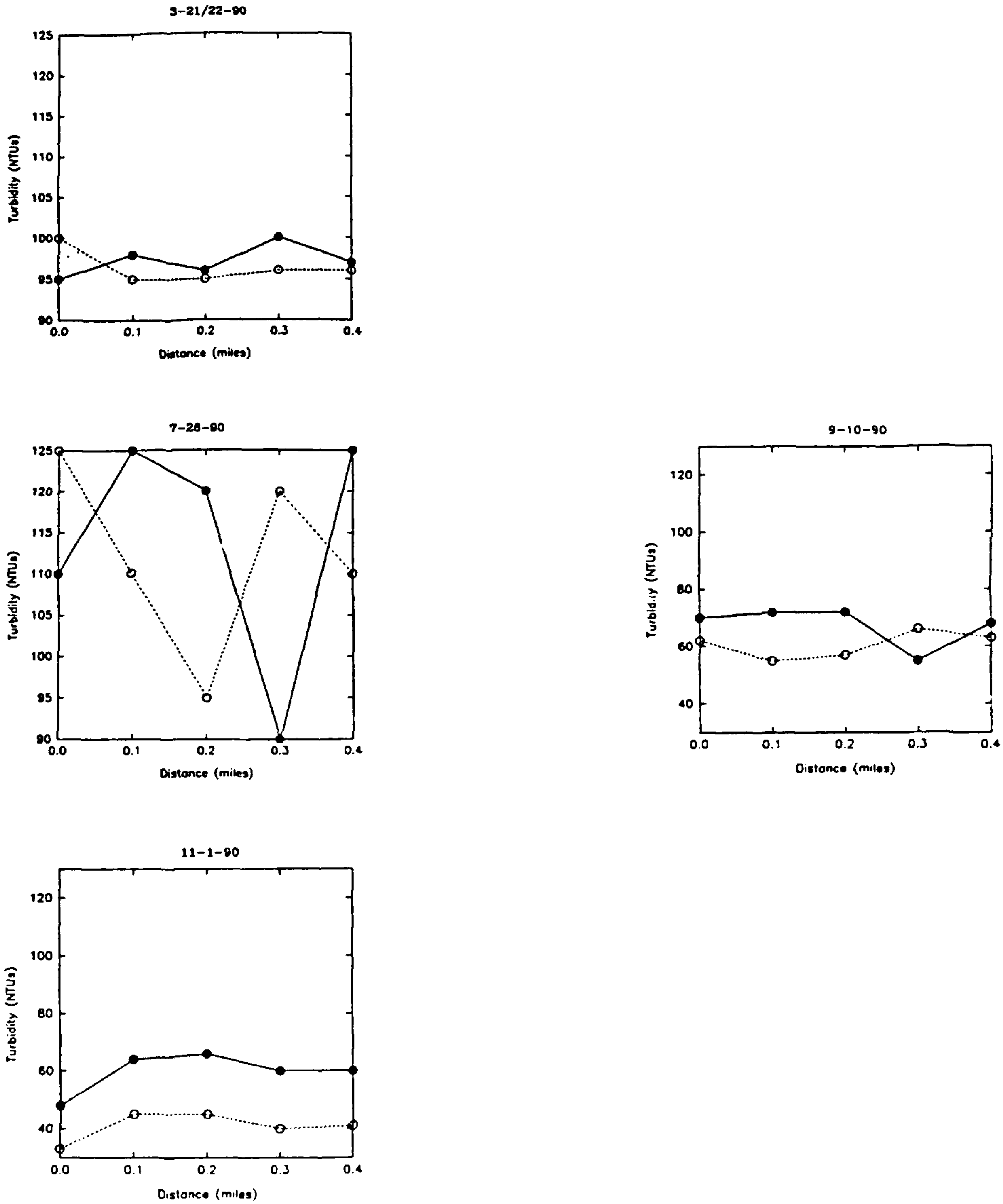


Figure III-1. Turbidity data from channelized (solid circle) and unchannelized (hollow circle) reaches during four sampling periods

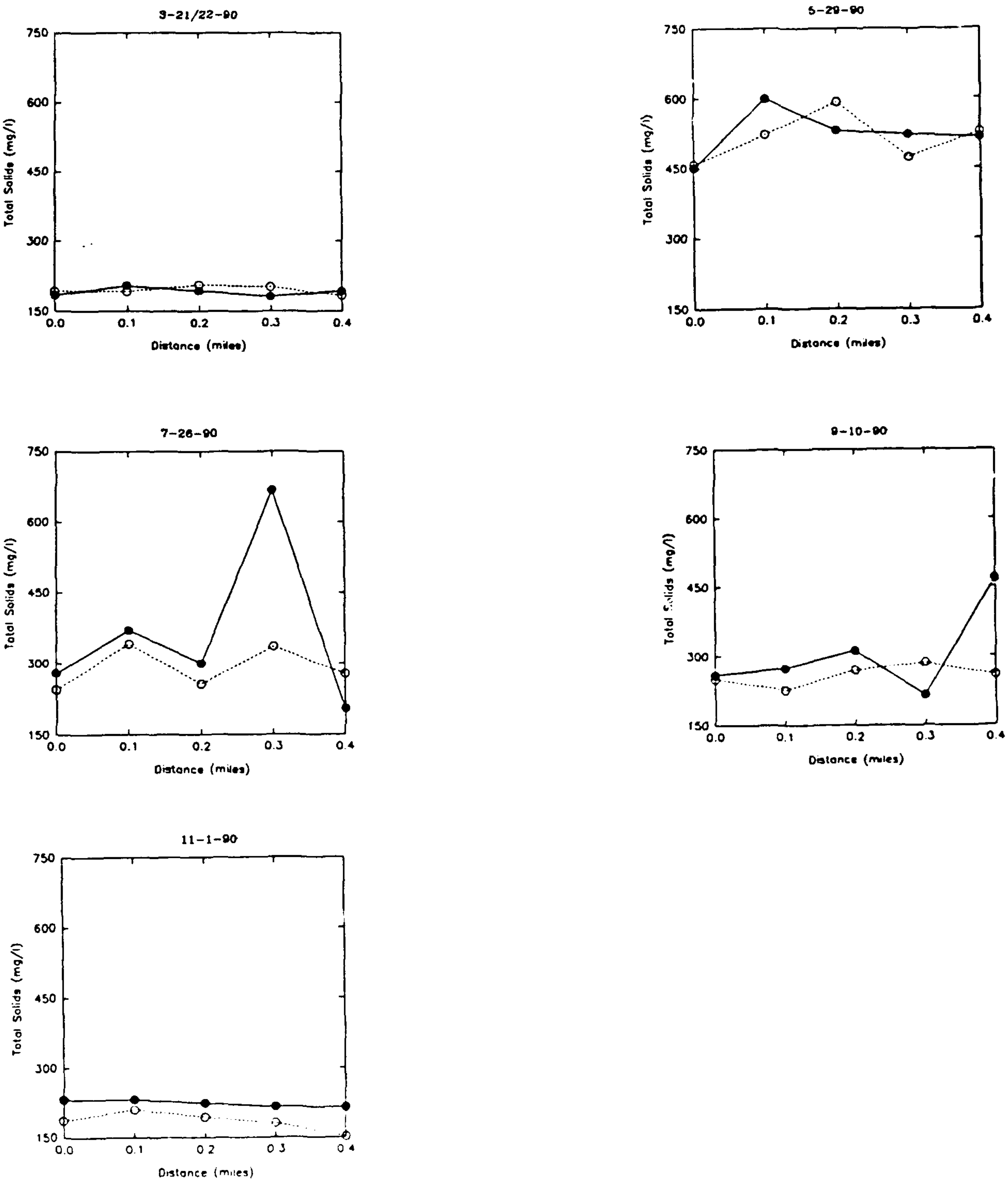


Figure III-2. Total solids data from channelized (solid circle) and unchannelized (hollow circle) reaches during five sampling periods

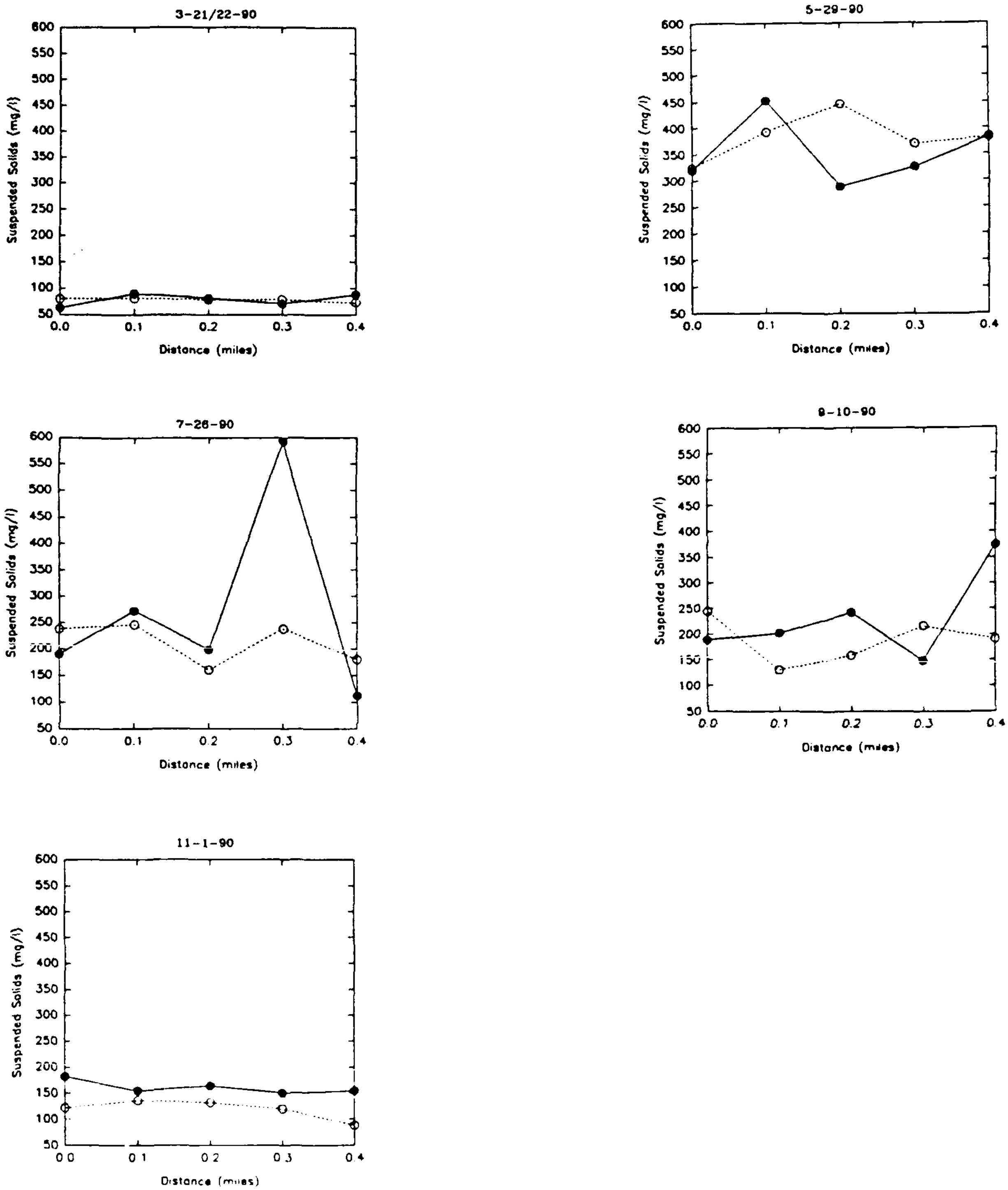


Figure III-3. Total suspended solids data from channelized (solid circle) and unchannelized (hollow circle) reaches during five sampling periods

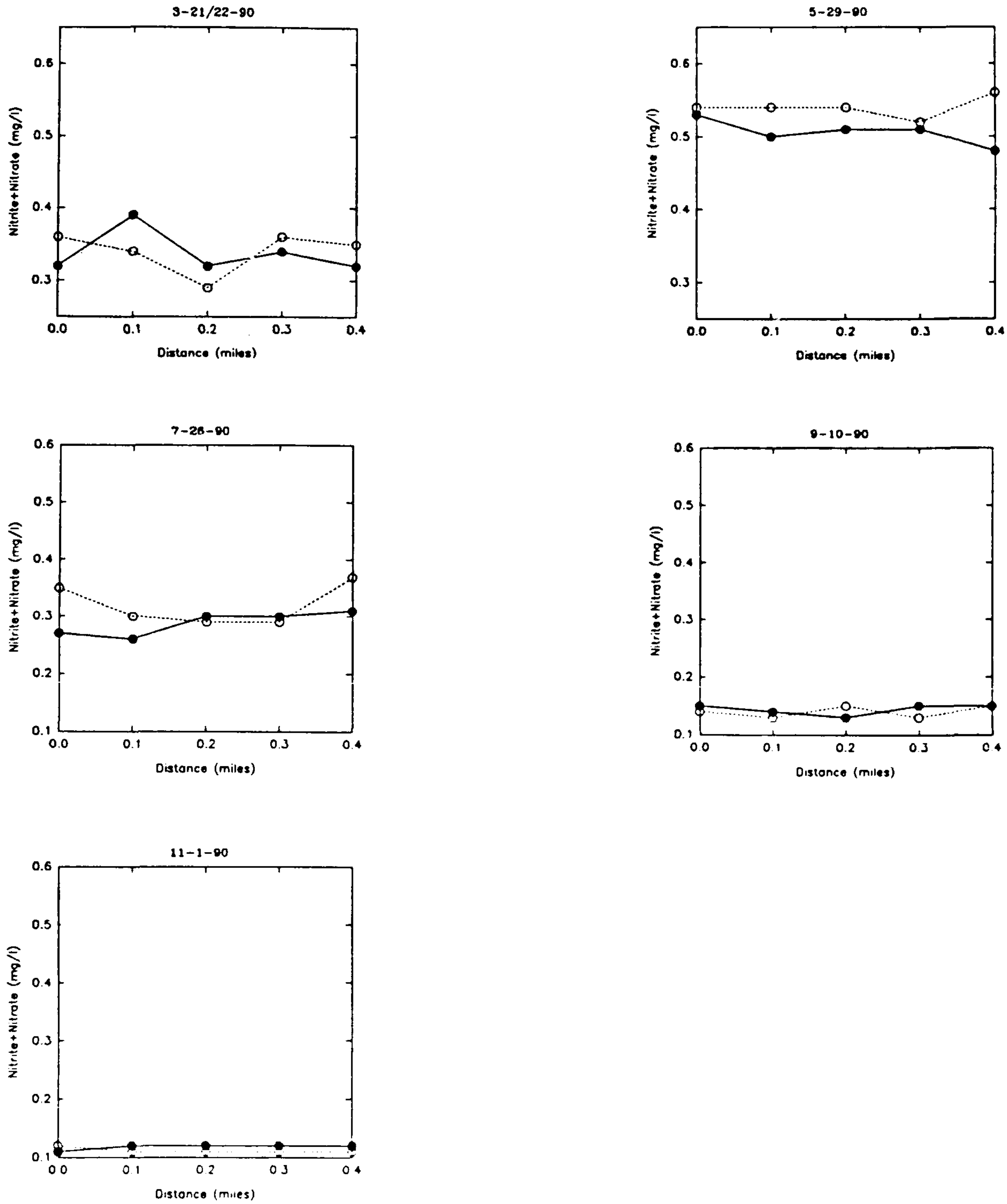


Figure III-4. Nitrate+nitrite data from channelized (solid circle) and unchannelized (hollow circle) reaches during five sampling periods

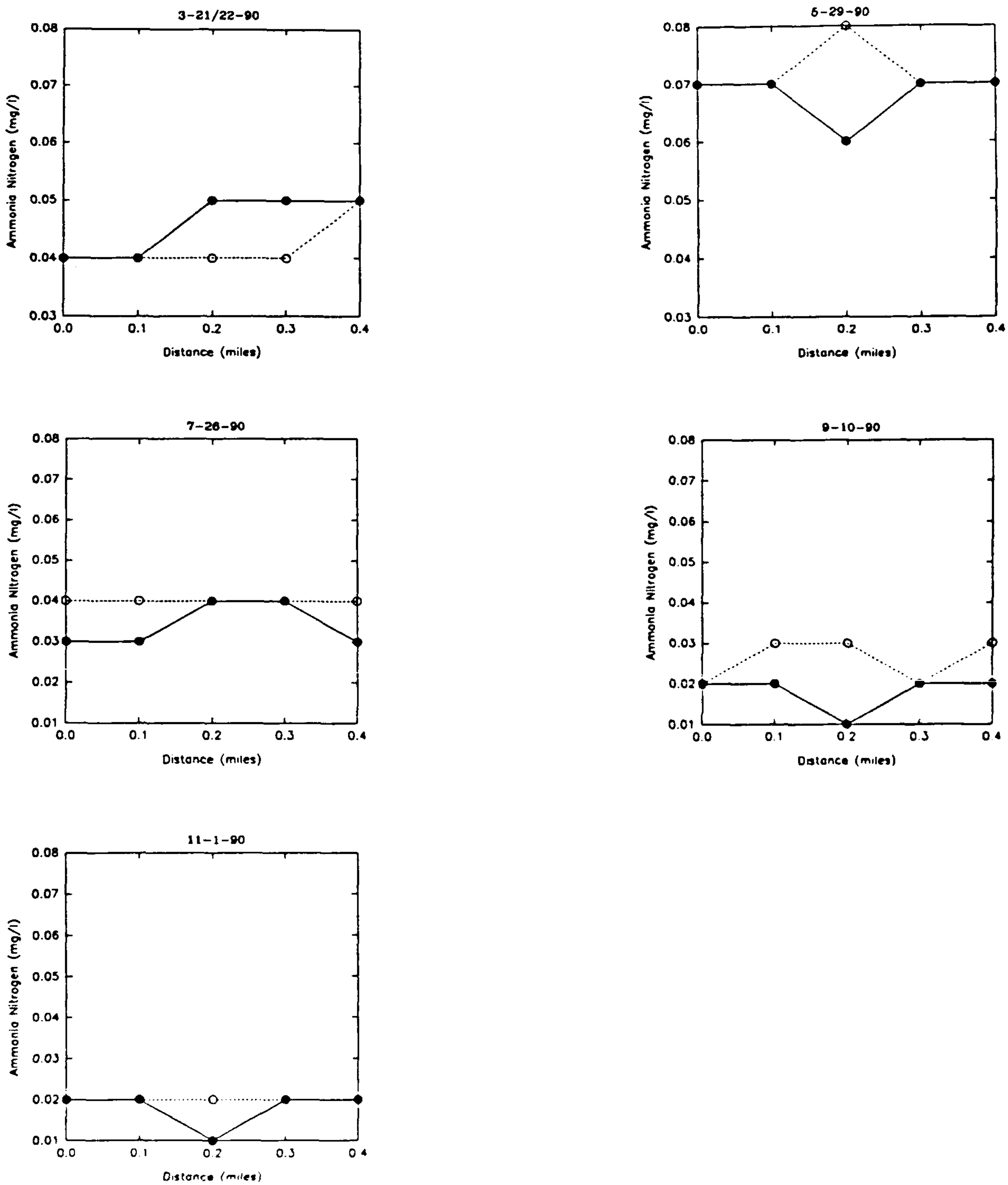


Figure III-5. Ammonia nitrogen data from channelized (solid circle) and unchannelized (hollow circle) reaches during five sampling periods

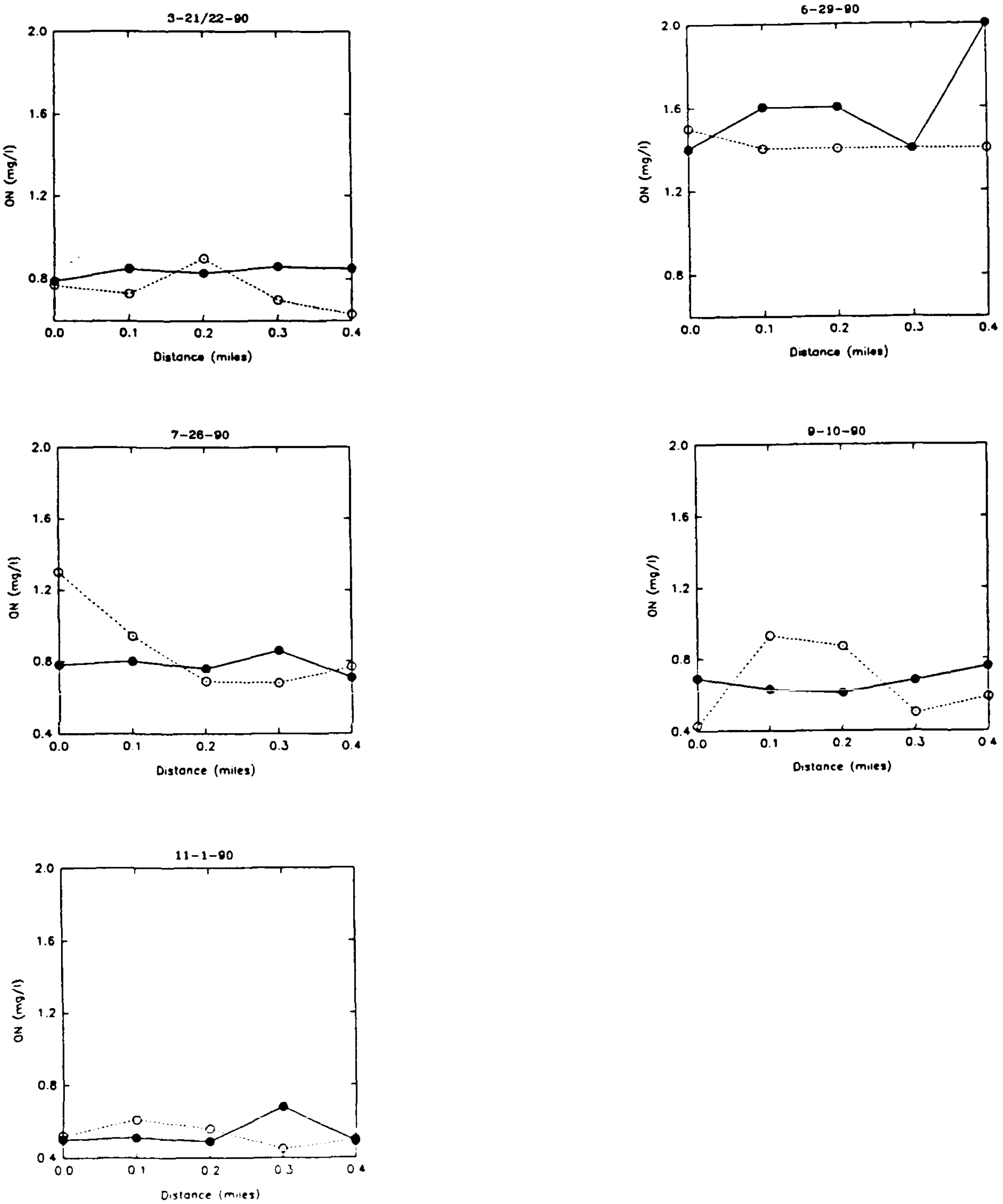


Figure III-6. Organic nitrogen data from channelized (solid circle) and unchannelized (hollow circle) reaches during five sampling periods

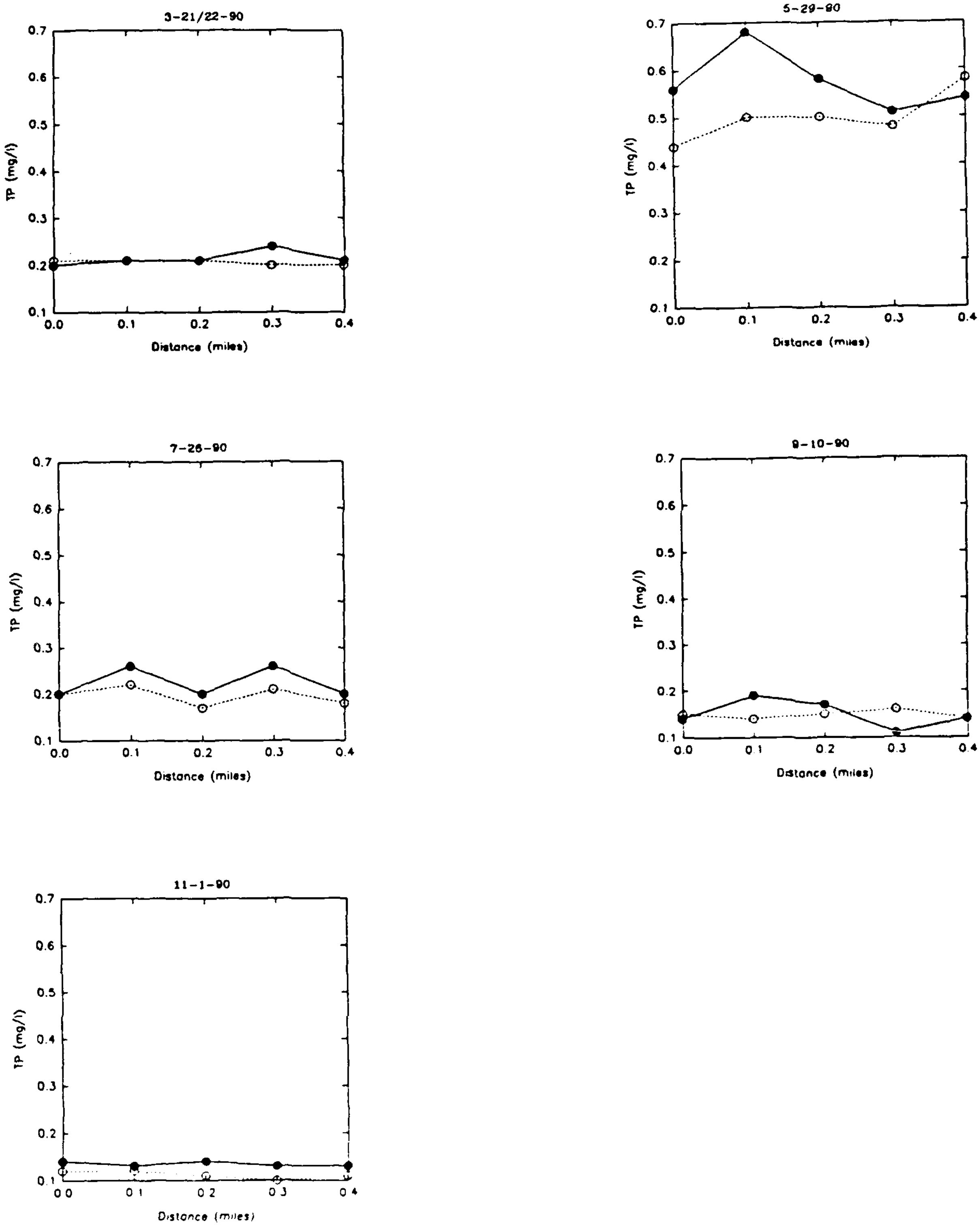


Figure III-7. Total phosphorus data from channelized (solid circle) and unchannelized (hollow circle) reaches during five sampling periods

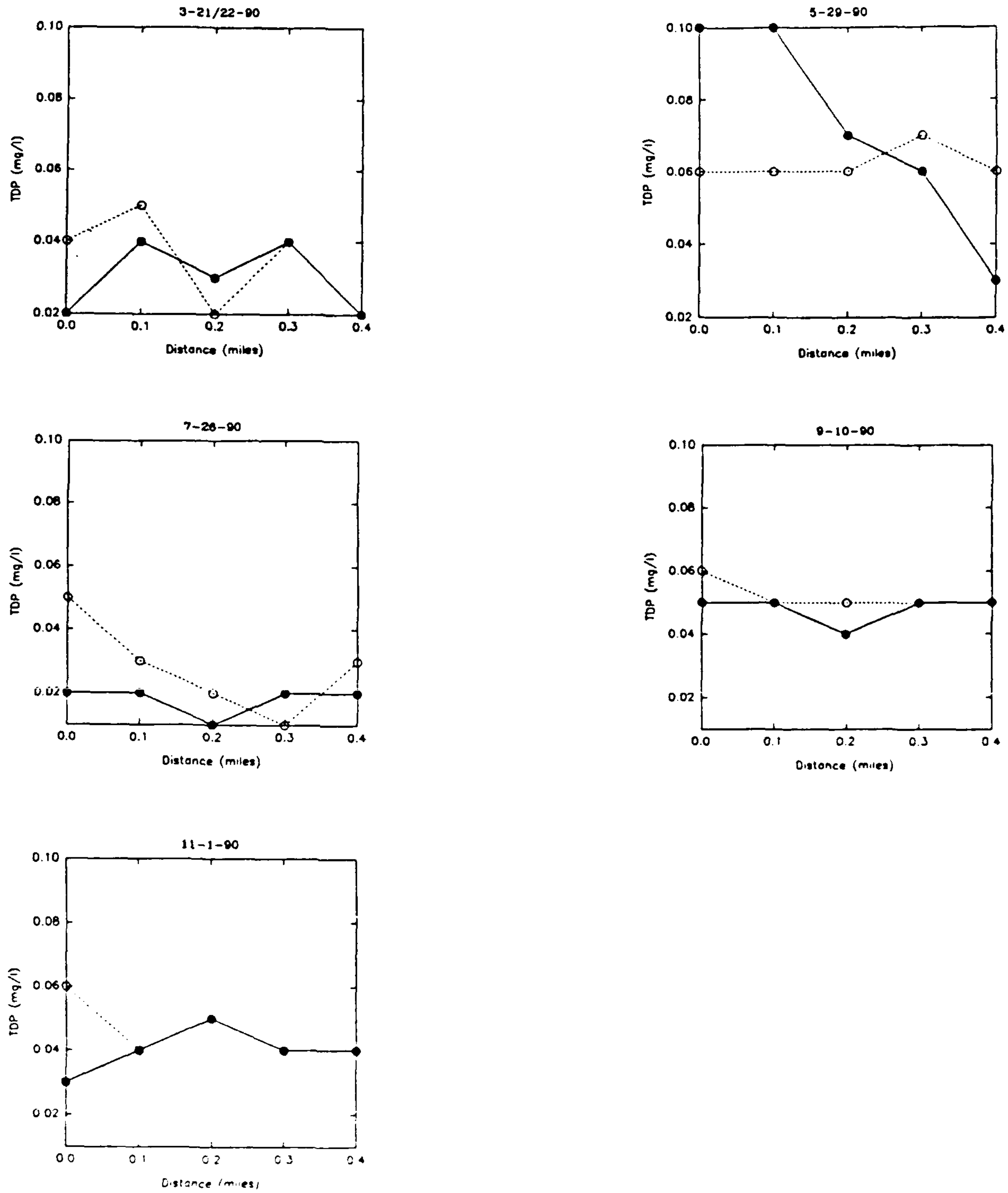


Figure III-8. Total dissolved phosphorus data from channelized (solid circle) and unchannelized (hollow circle) reaches during five sampling periods

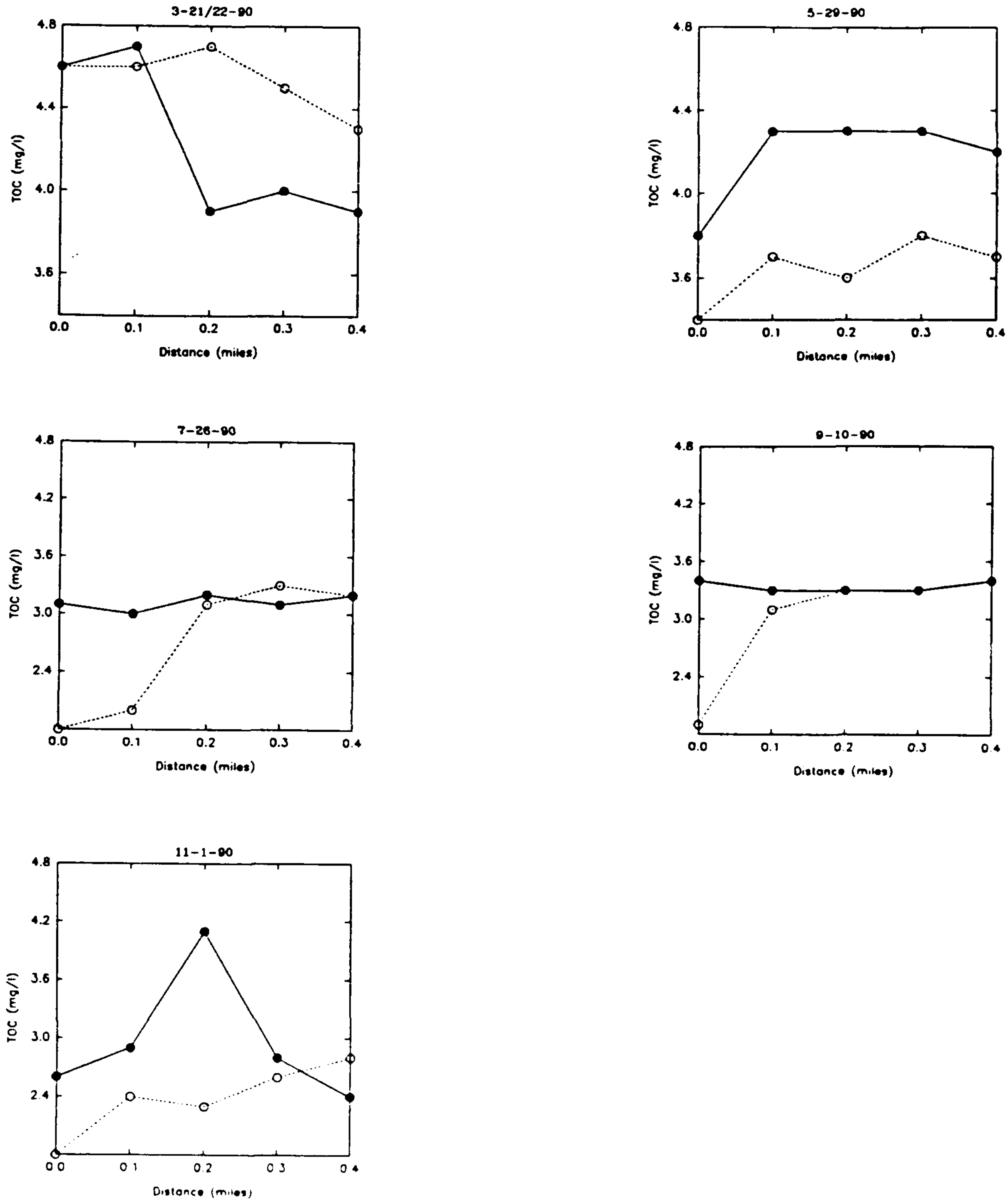


Figure III-9. TOC data from channelized (solid circle) and unchannelized (hollow circle) reaches during five sampling periods

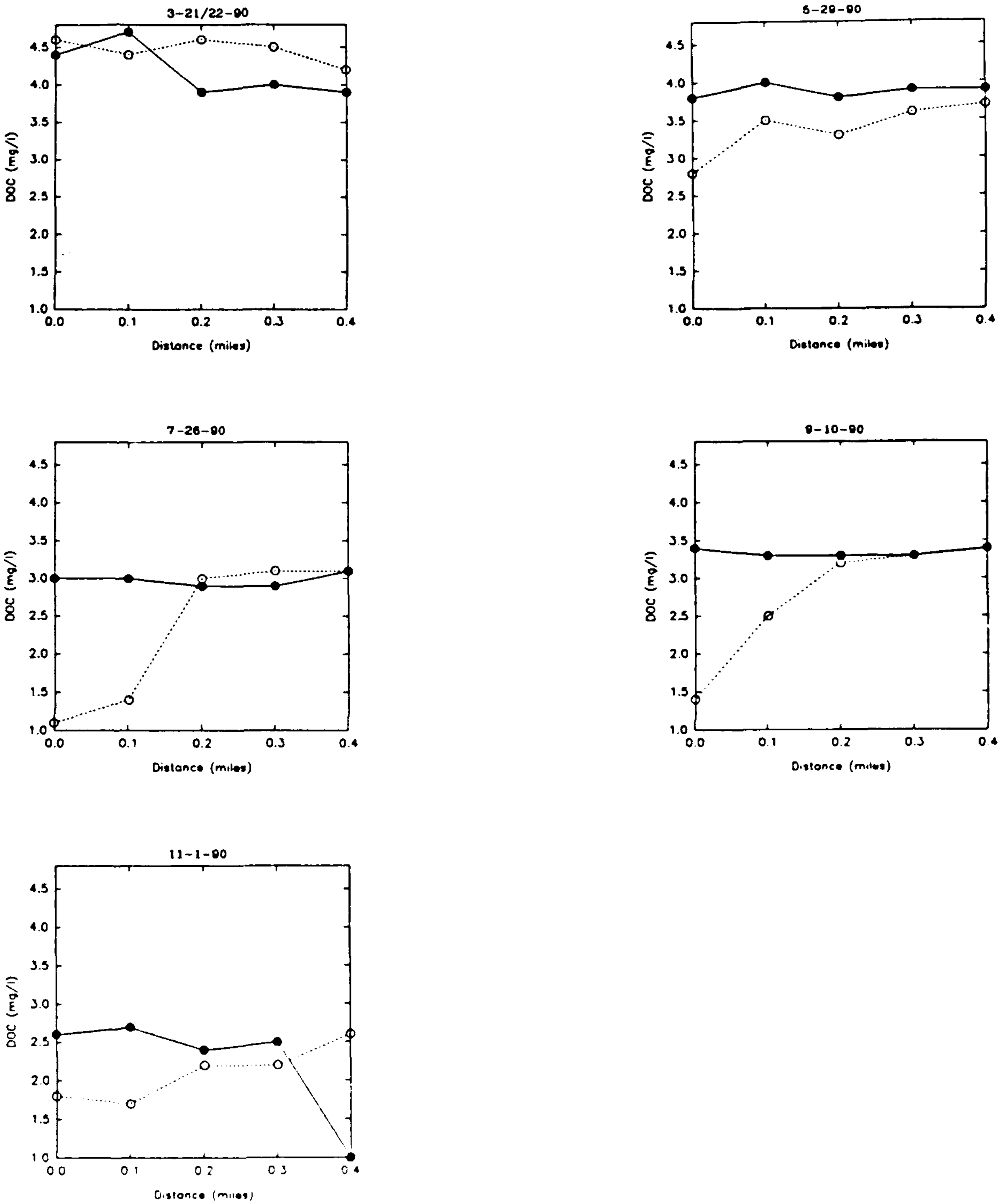


Figure III-10. DOC data from channelized (solid circle) and unchannelized (hollow circle) reaches during five sampling periods

PART IV: PESTICIDE CONTAMINATION OF SEDIMENTS

Background

Locations of sampling sites in the UYP area are shown in Figures IV-1 through IV-4. A description of the location of each sampling site, Universal Transverse Mercator Coordinates (UTMs), and sample type (surface [s] or core [c]) are provided in Tables IV-1 through IV-3 (and in Table V-2 for oxbow lake samples).

Sampling methods for core and surface samples as well as analytical methods and detection limits are provided in Appendix A. Detection limits (Table A1) were <0.002 mg/kg for currently used insecticides and PCBs, <0.0002 mg/kg for chlorinated insecticides, and ranged from <0.1 to 0.23 mg/kg for herbicides. All cores were sectioned into 10-cm segments and numbered sequentially from the surface segment down, except for cores taken at Mossy Lake, which were divided into 15-cm segments, and cores from the Cotton Project, which were divided into 30-cm segments. Within the following text, segments may be assumed to be 10 cm unless exceptions are noted.

Bear Creek

The chlorinated insecticide PPDDT, and its metabolites, as well as HPTCL were the predominant pesticides detected in surface sediments from the Bear Creek watershed (Table IV-4). PPDDD ranged from a high of 0.068 mg/kg in Macon Lake (BC3) to below detection limits (<0.0002 mg/kg) in Wasp, Mossy, and Blue Lakes (BC1, BC5, and BC6, respectively). HPTCL was highest in Sky Lake (BC2) (0.0053 mg/kg) and lowest (<0.0002 mg/kg) in Wasp and Three Mile Lakes (BC1 and BC4, respectively). Endosulfan I (ENDOI), ENDOSU, ENDRIN, ENDALD, and HPTCLE occurred sporadically in the watershed and varied from <0.0002 to 0.0070 mg/kg (Table IV-4). All other pesticides and PCBs were below detection limits and were not included in Table IV-4. The only herbicide detected in the Bear Creek watershed was 2,4-D. Detectable quantities of 2,4-D were found in sediments from Macon Lake (BC3) (0.078 mg/kg) and Blue Lake (BC6) (0.302 mg/kg).

Concentrations of PPDDT and its metabolites, which were reported for sediments sampled through 1979 in the Bear Creek area, were substantially higher than sediment concentrations found in 1990. Average concentrations of

PPDDE, PPDDD, and PPDDT (and associated standard errors) from historical Bear Creek data (Cotton and Herring 1970; Cotton 1976; Cooper et al. 1987) are compared to sediment data collected in 1990 in Figures IV-5 through IV-7. Wolf Lake (W1) comparisons are also included in these figures. Data in these figures show a marked improvement in surface sediment quality from the 1970s to the present day. Cotton and Herring (1970) monitored pesticide levels in Mossy Lake and Wolf Lake in 1970. Detection limits for PPDDE, PPDDD, and PPDDT were 0.001 mg/kg compared to 0.0002 mg/kg today. Cotton (1976) conducted a water quality study on Bear Creek watershed and collected surface samples from Blue and Macon Lakes. Cooper et al. (1987) conducted a chemical assessment of Blue, Mossy, Macon, Three Mile, and Wasp Lakes in the Bear Creek watershed from 1976 to 1979. They sampled sediments from both outflow and inflow portions of these lakes for both the 0- to 20-cm and the 20 to 40-cm depth segments. Data summarized in Figures IV-5 through IV-7 are for the 0- to 20-cm depth segment of the Cooper et al. (1987) data. Cooper et al. (1987) concluded that the Bear Creek watershed served as a sink for pesticides. Comparison of data collected in 1990 with historical data indicated a decline in pesticide concentrations in surface sediments from the Bear Creek area.

PPDDT was below detection limits (<0.0002 mg/kg) throughout the sediment profile in Wasp Lake (BC1), but was detected in the first 15-cm depth segment in Mossy Lake (BC5) (0.0006 mg/kg) (Table IV-5). PPDDD and PPDDE were present in low concentrations in all core depth segments in the Bear Creek area. The highest concentration of either PPDDD or PPDDE was 0.037 mg/kg. As was the case for surface sediments, concentrations of PPDDT and its metabolites were substantially lower than concentrations measured in the past (Cotton and Herring 1970; Cotton 1976; Cooper et al. 1987). HPTCL residues in cores from the Bear Creek area were low (highest value of 0.0037 mg/kg) and were detected only in the deeper depth segments. DIELDRIN, ENDRIN, endosulfan II (ENDOII), and ENDOSU were detected in low concentrations in some of the 15-cm depth segments from the core at Mossy Lake. PCB 1254 was detected in the three upper depth segments of Wasp Lake in low concentrations (0.025 mg/kg or less).

Particle size data (Table IV-6) for Bear Creek sediments indicate that the sediment (surface and core) is predominantly fine-grained material (clay <2 μm, silt $\geq$2 to <50 μm), except in Macon Lake (BC3), where sand-sized particles (>50 μm) comprised 70 percent of the particle size fraction. Core sample data show that approximately 70 to 97% of the top five to six depth segments from Wasp (BC1) (10-cm core segments) and Mossy Lake (BC5)(15-cm core segments) is fine-grained material (<50 μm). Cooper et al. (1987) found that Bear Creek sediments serve as a long-term sink for pesticides.

Confined Disposal Facilities and Adjacent Fields

In general, pesticides that were detected in the confined disposal facilities (CDFs) were also detected in adjacent fields with rare exception (Table IV-7). This is illustrated in Figure IV-8 for PPDDE and PPDDT. PPDDE was generally found in much higher concentrations in the adjacent fields than in the CDFs. PPDDT was not detected in any of the CDFs, but was detected in adjacent fields with values ranging from below detection limits to 0.50 mg/kg. PPDDE was detected in all fields and in all CDFs, except CDF6. The highest PPDDE value was 0.0054 mg/kg at CDF1. In most cases PPDDE values were higher in the fields than in CDFs, with field concentrations ranging from 0.0006 mg/kg at field 7 (F7) to 0.095 mg/kg at F5. PPDDD occurred more frequently in the CDFs than in adjacent fields, but all concentrations were low. In field soils, A-BHC, B-BHC, and ENDOI were detected at low levels (F3, 0.0028 mg/kg; F4, 0.0013 mg/kg; and F5, 0.0005 mg/kg, respectively). D-BHC was detected at CDF3 (0.0003 mg/kg) only. HPTCL was also found in low concentrations in CDF and field samples.

Historical data from the Yazoo River, i.e., sediment and bank material removed prior to dredging and disposal into the CDFs, showed concentrations of PPDDT ranging from below detection limits (BDL) to 0.074, PPDDE from BDL to 0.071, and PPDDD from BDL to 0.06 mg/kg (Leone and Dupuy 1978, Bednor and Grantham 1980, Brightbill and Treadaway 1980). These values are generally higher than concentrations of pesticides detected in the CDFs in 1990, indicating that natural processes such as biodegradation are acting to reduce the pesticide concentrations following disposal in the CDFs. The continued presence of PPDDT and its metabolites in the field soils indicates that soils continue to be a source of these contaminants to the Yazoo River and its tributaries. Field soil pesticide concentrations measured in 1990 can be compared only to field soil data from the Bear Creek area. These comparisons are presented in Figure IV-9 and show much lower field soil concentrations of PPDDE, PPDDD, and PPDDT than in previous studies. Other soil data (Leone and Dupuy 1978, Bednor and Grantham 1980, Brightbill and Treadaway 1980) were not from agricultural fields, but from bank material subject to dredging.

The CDFs were generally higher in sand than were adjacent fields (Table IV-8). Soils in fields adjacent to CDFs were composed primarily of fine-grained material (75 to 85%).

Yazoo River Channel and Tributaries

Surface sediment contaminant concentrations in the Yazoo River and its tributaries, including Bear Creek, are summarized in Figure IV-10 for the four most commonly detected pesticides. These summary data show that sediment pesticide concentrations were low in all areas sampled, even in Bear Creek where concentrations were highest. Individual sample data for Yazoo River surface sediments are presented in Table IV-9. PPDDT, and its metabolites, and HPTCL were detected rarely and sporadically within Yazoo River surface sediments. The highest PPDDT value was 0.0019 mg/kg, detected above Egypt (YZ20); the highest PPDDE value was 0.0068 mg/kg, found at Gum Grove (YZ2); the highest PPDDD value was 0.0021 mg/kg, detected on the Yazoo River at Famosla Cutoff (YZ5); and the highest HPTCL value was 0.0018 mg/kg, in the Yazoo River at Phillips Town (YZ27). Herbicides were detected in sediments only at the Yazoo River at Sidon Cutoff (YZ28) (0.076 mg/kg 2,4-DB), Yazoo River above Egypt (YZ21) (0.037 mg/kg 2,4,5-T), *and at one channelized water* quality station (YZ9) (0.056 mg/kg 2,4-DB).

Pesticides were not widespread in surface sediments in the Yalobusha and Tallahatchie Rivers, nor in Tippo Bayou (Figure IV-10 and Table IV-9). HPTCL values ranged from 0.0008 to 0.0043 mg/kg, with most values below detection limits and the highest value detected in the Tallahatchie River at White Lake (T3). The highest PPDDT value of 0.0550 mg/kg was observed in the Yalobusha River at the bridge (YB2), while the highest value for both PPDDD and PPDDE, 0.018 mg/kg, was detected at Tippo Bayou at Platner (TB5).

Comparison of the data in Table IV-9 with data collected previously (Leone and Dupuy 1978, Bednor and Grantham 1980, Brightbill and Treadaway 1980) indicated that pesticide levels within the Yazoo River are declining. These three studies collected a limited number of bottom sediment samples (four total) from the center of the channel of the Yazoo River. Samples were from near Yazoo City (Leone and Dupy 1978), Belzoni (Brightbill and Treadway 1980), and Morgan City (Bednar and Grantham 1980). Among these three studies, PPDDD levels in sediment ranged from 0.0012 to 0.01 mg/kg. Present PPDDD levels are generally below detection limits. PPDDE levels measured in the three historical studies ranged from 0.0012 to 0.01 mg/kg during 1978 to 1980. Present PPDDD levels are generally below detection limits with a high value of 0.0014 mg/kg (Table IV-9). PPDDT levels during 1978 to 1980 ranged from 0.001 to 0.012 mg/kg, while present PPDDT levels are generally below detection limits with a high value of 0.0019 mg/kg. Sediment samples in the present study were taken in depositional areas, not in the high-energy center of the channel where the historical data were obtained. This implies that sediment pesticide concentrations were maximized in the 1990 study.

Results of chemical analyses of six sediment cores taken within the Yazoo River are shown in Table IV-10. Of these six cores, five (YZ15-YZ19) were taken in proximity within the Yazoo River (between river miles 141.46 and 142.69). Average concentrations and associated standard errors for PPDDD, PPDDE, PPDDT, and heptachlor for the six 30-cm core segments (YZ15-YZ19 cotton project cores) are presented in Figure IV-11. As seen in Figure IV-11, pesticide concentrations (mean and associated standard error) in the sediment profile obtained near the riverbanks (25 ft) were generally higher in concentration than in core profiles obtained 50 ft from the riverbanks. PPDDT or its metabolites were found in low concentrations in nearly all depth segments at sites YZ15 (25 ft, mile 141.46), YZ16 (25 ft, mile 142.02), and YZ18 (25 ft, mile 142.02). Pesticide concentrations in the cores obtained 25 ft from the banks of the Yazoo River (YZ15, YZ16, and YZ18) are shown in Figure IV-12. The highest value for PPDDT or its metabolites in any of the cores collected from the Yazoo River channel was 0.0380 mg/kg PPDDE at YZ15. HPTCL was found in all cores tested from the Yazoo River channel, but concentrations were low, with 0.0088 mg/kg in YZ18 the highest value found. DIELDRIN was found mainly at site YZ18 and had a high concentration of 0.0100 mg/kg. Sediment concentrations from 1978 and 1980 (Leone and Dupuy 1978; Brightbill and Treadaway 1980; Bednar and Grantham 1980) were substantially higher than those measured in 1990 (Table IV-10).

Sediment core data from the Upper Yazoo River tributaries show the only detectable concentrations of PPDDT and its metabolites in the first depth segment (Table IV-11). Values ranged from below detection limits to 0.013 mg/kg, with the highest values detected in Tippo Bayou (TB1) and in the Tallahatchie River (T2). PCB 1254 was detected in a few depth segments, with the highest concentration (0.0340 mg/kg) detected in the first depth segment of Tallahatchie River core (T2).

Particle size analysis of surface samples collected from the Yazoo River and upper tributaries (Tallachatchie and Yalobusha Rivers and Tippo Bayou) are presented in Table IV-12 and summarized in Figure IV-13. Surface sediments collected in the Yazoo River had a higher percentage of sand (78 to 100%) than fine material (0.0 to 6%) at all sites, except at the confluence of Wasp Lake and Yazoo River (YZ5), which was predominantly clay and silt. Surface sediment collected on the Yalobusha River at the bridge (YB2) had a higher percentage of sand (97.5%) than the other two Yalobusha sites (YB1 and YB3). Surface sediment within the Tallahatchie River and Tippo Bayou consisted mainly of fine-grained material, with the exception of Tippo Bayou-north (TB5), which had a slightly higher percentage of sand (52.5%). Surface sediments, which were predominantly sand, contained somewhat lower concentrations of the most commonly detected pesticides (Table IV-13).

Most cores did not vary greatly in particle size distribution with depth except YZ5, which increased in sand after the first two depth segments (Table IV-14). Most other cores were predominantly fine-grained material.

Potential Pesticide Uptake by Fish

The maximum whole-body bioaccumulation potential (WPB) of fish or other aquatic organisms exposed to pesticides contained in surface sediment was estimated using the Tier I evaluation equations given by McFarland and Clarke (1987). These equations describe the partitioning of nonpolar organic compounds such as pesticides between sediment organic carbon and the aquatic organism lipid pools. This is a worst-case prediction of bioaccumulation if sediment is the only source of the contaminant to the organism. Mean lipid concentrations are from fish sampled in and around the Yazoo Refuge in May 1990.* Lipid concentrations in fish and maximum WPB for the surface sediment station [Macon Lake (BC3)] with the highest bioaccumulation potential for PPDDE, PPDDD, and PPDDT are presented in Table IV-15. Predicted concentrations of PPDDD, PPDDE, and PPDDT in fish at Macon Lake (BC3) are considerably higher than measured sediment concentrations at Macon Lake. However, predicted whole body concentrations of PPDDT, PPDDE, or PPDDD did not

* Personal Communication, Steve Smith, US Fish and Wildlife Service, 7 March 1991.

exceed the United States Food and Drug Administration (FDA) Action Level of 5 mg/kg for any single compound or summation of concentrations.

Bioaccumulation of PPDDT, PPDDD, and PPDDE from contaminated sediments is favored by high lipid concentrations in fish and low sediment total organic carbon concentrations. Estimated pesticide concentrations in fish indicate that sediment pesticides can potentially bioaccumulate in aquatic biota, even at the low sediment concentrations measured. This potential problem will remain endemic to the watershed as long as residues of pesticides such as PPDDT persist in sediments and soils that enter the waterway via runoff. However, it is expected that soil and sediment concentrations of chlorinated pesticides will continue to decrease in the UYP in the future, reducing the severity of potential bioaccumulation problems.

Table IV-1

Locations of Sampling Stations Within the Bear Creek Watershed

Stations	UTM Coordinates* (X,Y) X	UTM Coordinates* (X,Y) Y	Sample Type**
Wasp Lake (BC1) is located in Humphreys County about 3 1/2 miles north of Belzoni on Highway 7. Water quality Station 11.	737656	3678149	S and C
Sky Lake (BC2) is located in Humphreys County about 5 miles north of Belzoni and 1 mile west of Wasp Lake. No water quality station at this location.	732187	3685140	S
Macon Lake (BC3) is located in Sunflower County approximately 7 1/2 miles east of Inverness on the Inverness-Swiftown Road. Water quality Station 7.	733423	3693588	S
Three Mile Lake (BC4) is located in the lower end of Sunflower County on the Inverness-Swiftown Road. Water quality Station 8.	732818	3693560	S
Mossy Lake (BC5) is located in Leflore County between Morgan City and Swiftown off Highway 7. Water quality Station 6.	742320	3693681	S and C
Blue Lake (BC6) is located in Leflore County near Itta Bena. Water quality Station 1.	744955	3706357	S

* Universal Transverse Mercator, Zone 15.

** S indicates surface sediment sample; C indicates sediment core.

Table IV-2

Locations of Confined Disposal Facilities (CDFs) and Adjacent Fields (Fs)*

Station	UTM Coordinates** X	UTM Coordinates** Y	Sediment Type+
CDF1 and F1 are located approximately 2 miles west of Yazoo City on the west side of the Yazoo River off Highway 49.	739820	3639120	C
CDF2 and F2 are located approximately 3 miles north of CDF1 on the west side of the Yazoo River near Pleasant Green Church.	740220	3643420	C
CDF3 and F3 are located on the west side of the Yazoo River approximately 7 miles north of CDF2 near Cedar Falls School.	742420	3650620	C
CDF4 and F4 are located in Humphreys County on the east side of the Yazoo River about 5 miles off Highway 49 East.	742420	3660020	C
CDF5 and F5 are located on the east side of the Yazoo River approximately 4 miles from CDF4.	740220	3663720	C
CDF6 and F6 are located on the west side of the Yazoo Yazoo River approximately 1 1/2 mile from the Famosla cutoff.	744520	3682520	C
CDF7 and F7 are located 1 mile north of CDF6 on the west side of the Yazoo River.	743920	3681820	C

* All field soils sampled were under cultivation.

** Universal Transverse Mercator, Zone 15.

\+ S indicates surface sediment sample; C indicates sediment core.

Table IV-3

Locations and Sample Types Along the Yazoo River and Its Tributaries

Station	Location	UTM Coordinates* (X,Y) X	UTM Coordinates* (X,Y) Y	Sediment Type**
YZ1	Yazoo River at Roseneath	740052	3660494	S
YZ2	Yazoo River at Gum Grove	738809	3664365	S
YZ3	Yazoo River at Silver City	734141	3665184	S
YZ4	Yazoo River at Hard Cash Lake	733056	3669183	S
YZ5	Confluence of Wasp Lake and Yazoo River	741132	3675379	S and C
YZ6	Yazoo River at Famosla Cutoff	741972	3681304	S
YZ7	Yazoo River at Silent Shade	745702	3685064	S
YZ8-12	Yazoo River (water quality sites)	746067	3687170	S
YZ13	Yazoo River at Montgomery	748846	3688831	S
YZ14	Yazoo River at Archer Landing	752033	3689584	S
YZ15-19	Yazoo River below Egypt (cotton Project cores)	753224	3692112	C
YZ20-24	Yazoo River above Egypt (water quality sites)	752698	3693491	S
YZ25	Yazoo River at Aldeman Landing	749260	3696076	S
YZ26	Yazoo river at Sheppard Town	750053	3697548	S
YZ27	Yazoo River at Phillips Town	753807	3698472	S
YZ28	Yazoo River at Sidon Cutoff	755200	3700068	S
YB1	Yalobusha River-downstream	768189	3726441	S
YB2	Yalobusha River-at bridge	767435	3728014	S and C
YB3	Yalobusha River-upstream	766905	3729200	S

(Continued)

* Universal Transverse Mercator, Zone 15.

** S indicates surface sediment sample; C indicates sediment core.

(Sheet 1 of 2)

Table IV-3 (Concluded)

Station	Location	UTM Coordinates* (X,Y) X	Y	Sediment Type**
T1	Tallahatchie River at Sandy Ridge	757342	3733136	S
T2	Tallahatchie River-Strider Taylor	756275	3762693	S and C
T3	Tallahatchie-White Lake	758684	3768721	S
T4	Tallahatchie-Panola	765451	3769536	S
T5	Tallahatchie-Willow Lake	755459	3781173	S
TB1	Tippo Bayou South	765960	3740028	S and C
TB2	Tippo Bayou-Hard Time Lake	762652	3745950	S
TB3	Tippo Bayou- Ascalmore Creek	765349	3747661	S
TB4	Tippo Bayou-Platner	764357	3754679	S
TB5	Tippo Bayou North	760885	3755737	S
TB6	Tippo Bayou-Tandy	762070	3761680	S

* Universal Transverse Mercator, Zone 15.
** S indicates surface sediment sample; C indicates sediment core.

Sheet 2 of 2)

Table IV-4

Chemical Analyses of Surface Sediments from the Bear Creek Watershed

	Parameters										
Station	TOC (mg/kg)	PPDDD (mg/kg)	PPDDE (mg/kg)	PPDDT (mg/kg)	HPTCL (mg/kg)	ENDOI (mg/kg)	ENDOSU (mg/kg)	ENDRIN (mg/kg)	ENDALD (mg/kg)	HPTCLE (mg/kg)	METOXYCL (mg/kg)
BC1	10840	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
BC2	48145	.0075	.0140	<.0002	.0053	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
BC3	8481	.0680	.0230	.0093	.0006	<.0002	<.0002	<.0002	<.0002	.0002	<.0002
BC4	9730	.0380	<.0002	.0200	<.0002	<.0002	<.0002	<.0002	.0019	<.0002	<.0002
BC5	26473	<.0002	<.0002	<.0002	.0039	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
BC6	25705	<.0002	.0440	<.0002	.0016	.0056	.0070	.0009	<.0002	<.0002	<.0002

Table IV-5

Chemical Analyses of Sediment Cores from the Bear Creek Watershed

		Parameters									
Station	Depth	TOC (mg/kg)	PPDDD (mg/kg)	PPDDE (mg/kg)	PPDDT (mg/kg)	HPTCL (mg/kg)	DIELDRIN (mg/kg)	ENDOII (mg/kg)	ENDOSU (mg/kg)	ENDRIN (mg/kg)	PCB-12 (mg/kg)
BC1*	1	10840	<.0002	**.0020**	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	**.018**
	2	7260	<.0002	<.0002	<.0002	**.0018**	<.0002	<.0002	<.0002	<.0002	**.025**
	3	5630	<.0002	<.0002	<.0002	**.0022**	<.0002	<.0002	<.0002	<.0002	**.024**
	4	5950	**.0017**	**.0028**	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.002
BC5**	1	24790	**.0130**	**.0370**	**.0006**	<.0002	<.0002	<.0002	<.0002	<.0002	<.002
	2	23730	<.0002	<.0002	<.0002	<.0002	**.0026**	<.0002	<.0002	**.0007**	<.002
	3	14910	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.002
	4	31670	<.0002	<.0002	<.0002	**.0037**	<.0002	<.0002	<.0002	<.0002	<.002
	5	38610	<.0002	<.0002	<.0002	<.0002	<.0002	**.0010**	**.0008**	<.0002	<.002
	6	32900	<.0002	<.0002	<.0022	<.0002	<.0002	<.0002	<.0002	**.0006**	<.002

* Depth in 10-cm segments.
** Depth in 15-cm segments.

Table IV-6

Particle Size Distribution in Surface and Core Sediment Samples from Bear Creek

Station	Depth (ft)	% Clay	% Silt	% Sand
BC1	S*	40.0	27.5	32.5
BC2	S	52.5	45.0	2.5
BC3	S	17.5	12.5	70.0
BC4	S	35.5	17.5	47.5
BC5	S	62.5	35.0	2.5
BC6	S	52.5	40.0	7.5
BC1	1	40.0	27.5	32.5
	2	40.0	32.5	27.5
	3	45.0	40.0	15.0
	4	45.0	30.0	25.0
	5	45.0	35.0	20.0
BC5	1	37.5	37.5	25.0
	2	40.0	35.0	25.0
	3	35.0	62.5	2.5
	4	32.5	65.0	2.5
	5	30.0	45.0	25.0
	6	32.5	42.5	25.0

* Surface sediment sample.

Table IV-7

Concentrations of Pesticides in Confined Disposal Facilities (CDFs) and Adjacent Fields (Fs)

Station	TOC (mg/kg)	A-BHC (mg/kg)	B-BHC (mg/kg)	D-BHC (mg/kg)	PPDDD (mg/kg)	PPDDE (mg/kg)	PPDDT (mg/kg)	HPTCL (mg/kg)	ENDOI (mg/kg)	ENDALD (mg/kg)
CONFINED DISPOSAL FACILITIES										
CDF1	11030	<.0002	<.0002	<.0002	.0051	.0054	<.0002	<.0002	<.0002	<.0002
CDF2	3920	<.0002	<.0002	<.0002	<.0002	.0004	<.0002	.0005	<.0002	<.0002
CDF3	6450	<.0002	<.0002	.0003	<.0002	.0020	<.0002	.0007	<.0002	<.0002
CDF4	4390	<.0002	<.0002	<.0002	.0009	.0005	<.0002	.0004	<.0002	<.0002
CDF5	5550	<.0002	<.0002	<.0002	<.0002	.0003	<.0002	<.0002	<.0002	<.0002
CDF6	5340	<.0002	<.0002	<.0002	.0006	<.0002	<.0002	<.0002	<.0002	<.0002
CDF7	6890	<.0002	<.0002	<.0002	<.0002	.0007	<.0002	<.0002	<.0002	<.0002
ADJACENT FIELDS										
F1	7240	<.0002	<.0002	<.0002	.0140	.0140	.2200	.0008	<.0002	<.0002
F2	6190	<.0002	<.0002	<.0002	<.0002	.0016	<.0002	.0008	<.0002	<.0002
F3	4100	<.0002	.0028	<.0002	<.0002	.0360	.1700	<.0002	<.0002	<.0002
F4	7390	<.0002	<.0002	<.0002	<.0002	.0062	.0140	.0008	.0013	<.0008
F5	4070	.0005	<.0002	<.0002	<.0002	.0950	.5000	<.0002	<.0002	<.0002
F6	5690	<.0002	<.0002	<.0002	<.0002	.0100	.0420	<.0002	<.0002	<.0002
F7	8980	<.0002	<.0002	<.0002	<.0002	.0006	<.0002	<.0002	<.0002	<.0002

Table IV-8

Particle Size Distribution in Sediment from Confined Disposal Facilities (CDFs) and Adjacent Fields (Fs)

Station	% Clay	% Silt	% Sand
CDF1	25.0	62.5	12.5
CDF2	2.5	7.5	90.0
CDF3	17.5	37.5	45.0
CDF4	2.5	7.5	90.0
CDF5	15.0	20.0	65.0
CDF6	2.5	7.5	90.0
CDF7	22.5	35.0	42.5
F1	25.0	60.0	15.0
F2	27.5	57.5	15.0
F3	15.0	62.5	22.5
F4	30.0	45.0	25.0
F5	5.0	57.5	27.5
F6	22.5	60.0	17.5
F7	40.0	35.0	25.0

Table IV-9

Pesticide Concentrations in Surface Sediments in the Yazoo River and Upper Tributaries

Station	TOC (mg/kg)	PPDDD (mg/kg)	PPDDE (mg/kg)	PPDDT (mg/kg)	HPTCL (mg/kg)
		Parameters*			
YZ1	2860	<.0002	<.0002	<.0002	<.0002
YZ2	6180	<.0002	.0068	<.0002	.0008
YZ3	3050	.0014	<.0002	<.0002	<.0002
YZ4	2652	<.0002	.0007	<.0002	<.0002
YZ6	2310	.0021	<.0002	.0013	<.0002
YZ7	2380	<.0002	<.0002	<.0002	<.0002
YZ8	2830	<.0002	.0005	<.0002	<.0002
YZ9	3440	<.0002	<.0002	<.0002	.0012
YZ10	2670	<.0002	<.0002	<.0002	.0009
YZ11	2270	.0009	<.0002	<.0002	<.0002
YZ12	2520	<.0002	<.0002	<.0002	<.0002
YZ13	3390	<.0002	<.0002	<.0002	<.0002
YZ14	2270	<.0002	<.0002	<.0002	.0017
YZ20	2700	<.0002	<.0002	.0019	<.0002
YZ21	3310	<.0002	<.0002	<.0002	<.0002
YZ22	3660	<.0002	<.0002	.0010	<.0002
YZ23	1970	<.0002	<.0002	.0009	<.0002
YZ24	2270	<.0002	<.0002	<.0002	<.0002
YZ25	2310	<.0002	<.0002	<.0002	<.0002
YZ26	3060	<.0002	<.0002	.0005	<.0002
YZ27	1860	<.0002	<.0002	<.0002	.0018
YZ28	2280	<.0002	<.0002	<.0002	<.0002
YB1	5890	<.0002	<.0002	<.0002	<.0002
YB2	5410	<.0002	<.0002	.0550	<.0002
YB3	5980	<.0002	<.0002	<.0002	.0008
T1	5990	<.0002	<.0002	<.0002	.0012
T2	4130	<.0002	<.0002	<.0002	<.0002
T3	6390	<.0002	<.0002	<.0002	.0043
T4	3030	<.0002	<.0002	<.0002	<.0002
T5	5690	.0100	<.0002	<.0002	.0019
TB1	5630	<.0002	<.0002	<.0002	<.0002
TB2	19980	<.0002	<.0002	<.0002	<.0002
TB3	5970	<.0002	<.0002	<.0002	.0013
TB4	2650	.0180	.0180	.0015	<.0002
TB5	13250	.0011	<.0002	<.0002	<.0002
TB6	17280	<.0002	<.0002	<.0002	<.0002

* Samples were analyzed for other, but no values were above detection limits.

Table IV-10

Analytical Results for Sediment Cores from the Yazoo River

		Parameters									
Station	Depth	TOC (mg/kg)	D-BHC (mg/kg)	ALDRIN (mg/kg)	PPDDD (mg/kg)	PPDDE (mg/kg)	PPDDT (mg/kg)	HPTCL (mg/kg)	DIELDRIN (mg/kg)	ENDOI (mg/kg)	ENDRIN (mg/kg)
YZ5	1	1710	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0020	<.0002
	2	1500	<.0002	<.0002	<.0002	<.0002	<.0002	.0009	<.0002	<.0020	<.0002
	3	270	<.0002	<.0002	.0018	<.0002	<.0002	<.0002	<.0002	<.0020	<.0002
	4	150	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0020	<.0002
	5	260	<.0002	<.0002	<.0002	<.0002	<.0002	.0010	<.0002	<.0020	<.0002
YZ15	1	4167	<.0002	<.0002	.0015	.0019	.0015	<.0002	<.0002	<.0002	<.0002
	2	5860	<.0002	<.0002	.0040	.0040	.0012	.0014	<.0002	<.0002	<.0002
	3	4286	<.0002	<.0002	.0050	.0030	<.0002	.0011	<.0002	.0005	<.0002
	4	8858	<.0002	<.0002	.0380	.0120	<.0002	.0023	<.0002	<.0002	<.0002
	5	7539	<.0002	<.0002	.0110	.0072	<.0002	<.0002	<.0002	.0009	<.0002
	6	8447	<.0002	<.0002	.0040	.0052	.0035	.0009	<.0002	<.0002	<.0002
YZ16	1	5179	<.0002	<.0002	.0037	.0039	.0026	.0011	<.0002	.0009	<.0002
	2	8738	<.0002	<.0002	.0052	.0057	.0030	.0008	<.0002	<.0002	<.0002
	3	8317	<.0002	<.0002	.0110	.0110	.0055	.0016	<.0002	<.0002	<.0002
	4	7247	<.0002	<.0002	.0066	.0053	.0030	<.0002	<.0002	<.0002	<.0002
	5	5351	.0008	<.0002	.0049	.0041	.0016	<.0002	<.0002	<.0002	<.0002
	6	6665	<.0002	<.0002	.0205	.0320	.0073	.0015	<.0002	.0014	.0010
YZ17	1	3035	.0010	<.0002	<.0002	<.0002	<.0002	.0029	<.0002	<.0002	<.0002
	2	8378	<.0002	<.0002	<.0002	<.0002	<.0002	.0018	<.0002	.0014	<.0002
	3	4984	<.0002	<.0002	<.0002	<.0002	<.0002	.0020	<.0002	<.0002	<.0002
	4	8792	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	.0002	<.0002	<.0002
	5	2726	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
	6	8517	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002

(Continued)

Table IV-10 (Concluded)

Station	Depth	TOC (mg/kg)	ALDRIN (mg/kg)	D-BHC (mg/kg)	PPDDD (mg/kg)	PPDDE (mg/kg)	PPDDT (mg/kg)	HPTLC (mg/kg)	DIELDRIN (mg/kg)	ENDOI (mg/kg)	ENDRIN (mg/kg)
		Parameters									
YZ18	1	5991	<.0002	<.0002	<.0002	.0135	.0087	.0033	.0018	<.0002	<.0002
	2	3904	<.0002	<.0002	<.0002	.0130	.0080	.0033	.0009	<.0002	<.0002
	3	2308	<.0002	<.0002	<.0002	.0150	.0045	.0088	.0011	.0009	<.0002
	4	2919	<.0002	<.0002	<.0002	.0026	.0026	.0018	.0011	<.0002	<.0002
	5	5646	<.0002	<.0002	<.0002	.0055	.0034	.0026	.0100	<.0002	<.0002
	6	4905	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
YZ19	1	3523	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
	2	4280	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002
	3	2918	<.0002	<.0002	<.0002	<.0002	<.0002	.0011	<.0002	.0004	.0004
	4	5118	<.0002	<.0002	<.0002	<.0002	<.0002	.0029	<.0002	<.0002	<.0002
	5	5783	<.0002	<.0002	<.0002	<.0002	<.0002	.0023	.0008	<.0002	<.0002
	6	5397	.0005	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002

Table IV-11

Analytical Results for Sediment Cores from the Upper Yazoo River Tributaries

		Parameters						
Station	Depth	TOC (mg/kg)	PPDDD (mg/kg)	PPDDE (mg/kg)	PPDDT (mg/kg)	HPTLC (mg/kg)	HPTCLE (mg/kg)	PCB 1254 (mg/kg)
TB1	1	15940	**.0130**	**.0110**	**.0050**	<.0002	**.0005**	<.0020
	2	13000	<.0002	<.0002	<.0002	<.0002	<.0002	<.0020
	3	9540	<.0002	<.0002	<.0002	**.0016**	<.0002	<.0020
	4	5800	<.0002	<.0002	<.0002	**.0017**	<.0002	<.0020
	5	6500	<.0002	<.0002	<.0002	<.0002	<.0002	**.0150**
YB1	1	5250	<.0002	**.0024**	<.0002	<.0002	<.0002	<.0020
	2	5020	**.0030**	<.0002	<.0002	<.0002	<.0002	<.0020
	3	5780	**.0031**	<.0002	<.0002	<.0002	<.0002	<.0020
	4	7290	**.0031**	**.0025**	<.0002	<.0002	<.0002	<.0020
	5	6910	<.0002	<.0002	<.0002	<.0002	<.0002	<.0020
T2	1	1200	**.0029**	**.0037**	**.0054**	<.0002	<.0002	**.0340**
	2	1320	**.0028**	<.0002	<.0002	**.0009**	<.0002	<.0020
	3	1390	<.0002	<.0002	<.0002	<.0002	<.0002	<.0020
	4	2050	<.0002	<.0002	<.0002	<.0002	<.0002	**.0290**
	5	1690	**.0016**	**.0014**	**.0130**	**.0014**	<.0002	**.0210**
	6	NA*	<.0002	**.0014**	<.0002	<.0002	<.0002	<.0020

Table IV-12

Particle Size Distribution in Surface Sediment Samples from the Yazoo River and Upper Tributaries

Station	% Clay	% Silt	% Sand
YZ1	0.0	5.0	95.0
YZ2	18.8	38.7	42.5
YZ3	0.0	0.0	100.0
YZ4	0.0	0.0	100.0
YZ5	12.5	40.0	47.5
YZ6	0.0	5.0	95.0
YZ7	0.0	2.5	97.5
YZ8	0.0	0.0	100.0
YZ9	0.0	2.5	97.5
YZ10	0.0	2.5	97.5
YZ11	0.0	2.5	97.5
YZ12	0.0	5.0	95.0
YZ13	0.0	2.5	97.5
YZ14	0.0	2.5	97.5
YZ20	2.5	6.5	91.0
YZ21	1.5	6.5	92.0
YZ22	0.0	2.5	97.5
YZ23	0.0	2.5	97.5
YZ24	0.0	0.0	100.0
YZ25	0.0	2.5	97.5
YZ26	0.0	2.5	97.5
YZ27	0.0	2.5	97.5
YZ28	0.0	0.0	100.0
YB1	5.0	47.5	47.5
YB2	3.75	56.25	40.0
YB3	7.5	70.0	22.5
T1	10.0	67.5	22.5
T2	2.5	55.0	42.5
T3	13.5	76.5	10.0
T4	0.0	0.0	100.0
T5	11.25	76.25	12.5
TB1	37.5	47.5	15.0
TB2	28.7	43.8	27.5
TB3	25.0	37.5	37.5
TB4	20.0	40.0	40.0
TB5	10.0	37.5	52.5
TB6	30.0	62.5	7.5

Table IV-13

Mean Pesticide Concentrations (Standard Error) as a Function of Sand Content, Upper Yazoo Project Area

Pesticide	Sand Content, percent	
	>50%	<50%
PPDDE	0.00005 (0.00004)	0.0014 (0.0011)
PPDDD	0.00023 (0.00012)	0.0016 (0.0011)
PPDDT	0.00021 (0.00011)	0.0032 (0.0031)
HPTCL	0.00016 (0.00009)	0.0007 (0.0003)

Table IV-14

Particle Size Distribution in Core Sediment Samples from the Yazoo River and Upper Tributaries

Station	Depth	% Clay	% Silt	% Sand
YZ5	1	12.5	40.0	47.5
	2	12.5	22.5	65.0
	3	5.0	0.0	95.0
	4	2.5	0.0	97.5
	5	2.5	0.0	97.5
	6	2.5	0.0	97.5
YB2	1	12.5	55.0	32.5
	2	17.5	57.5	25.0
	3	15.0	55.0	30.0
	4	15.0	50.0	35.0
	5	15.0	52.5	32.5
TB1	1	50.0	27.5	22.5
	2	52.5	25.0	22.5
	3	52.5	20.0	27.5
	4	40.0	15.0	45.0
	5	32.5	17.5	50.0
T2	1	10.0	57.5	32.5
	2	12.5	65.0	22.5
	3	12.5	62.5	25.0
	4	12.5	62.5	25.0
	5	5.0	50.0	45.0
	6	12.5	50.0	37.5

Table IV-15

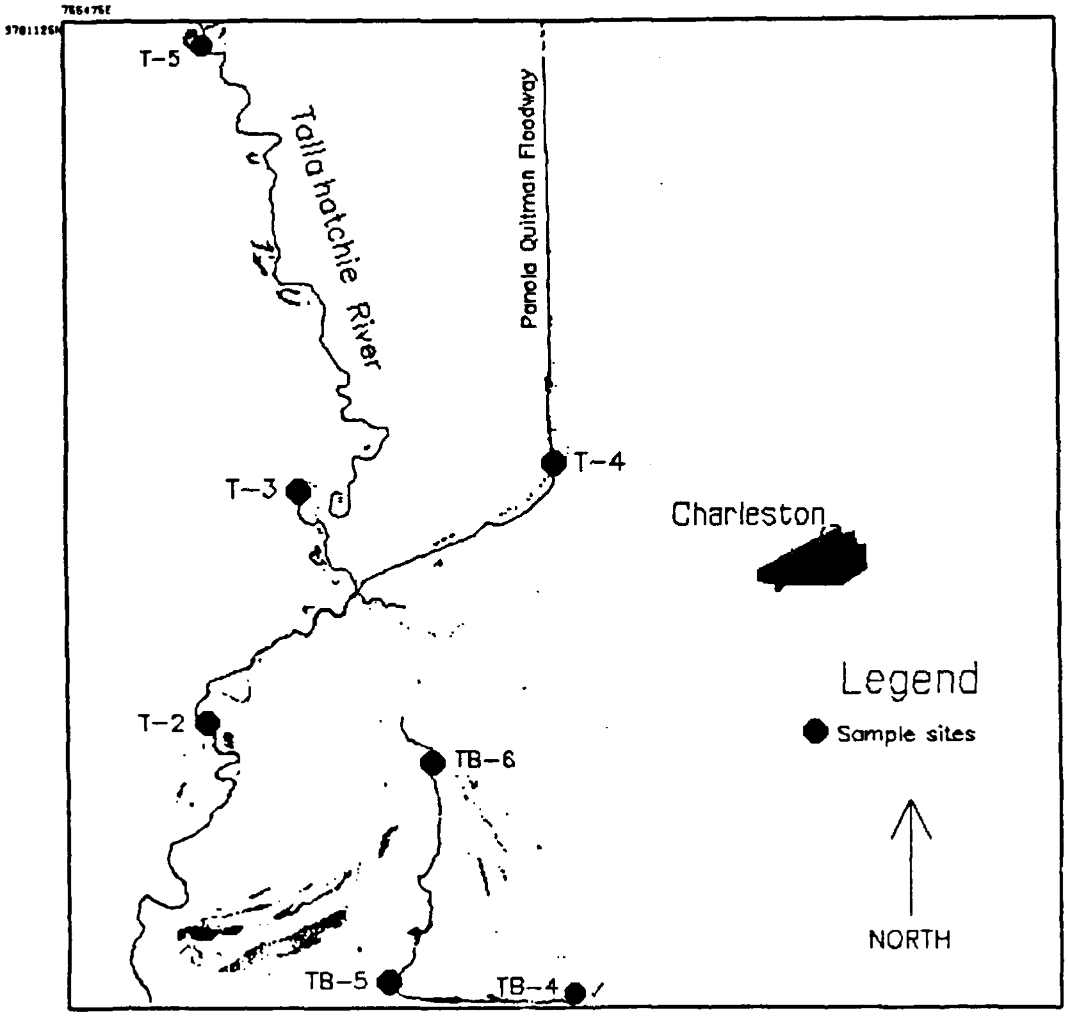
Predicted Maximum Whole Body Concentrations (WPB) of PPDDE, PPDDD, and PPDDT in Fish*

Fish	Percent Lipids**	Predicted WPB of PPDDE	Predicted WPB of PPDDD	Predicted WPB of PPDDT	Summation+
Carp	7.47 (1.64)	0.35	1.03	0.14	1.38
Spotted Gar	5.28 (3.55)	0.25	0.73	0.10	0.98
White Crappie	1.98 (0.96)	0.09	0.27	0.04	0.27
Shad	3.21 (1.27)	0.15	0.44	0.06	0.44
Small Mouth Buffalo	6.78 (1.25)	0.32	0.93	0.13	1.25
Large Mouth Bass	4.24	0.20	0.58	0.08	0.78
Black Crappie	3.03	0.14	0.42	0.06	0.42
Bowfin	4.28 (1.83)	0.20	0.59	0.08	0.79
Fresh Water Drum	6.54	0.30	0.90	0.12	1.20
Channel Catfish	3.73 (0.94)	0.17	0.51	0.07	0.51

* Predictions were based on pesticide data from Macon Lake (Station BC3).

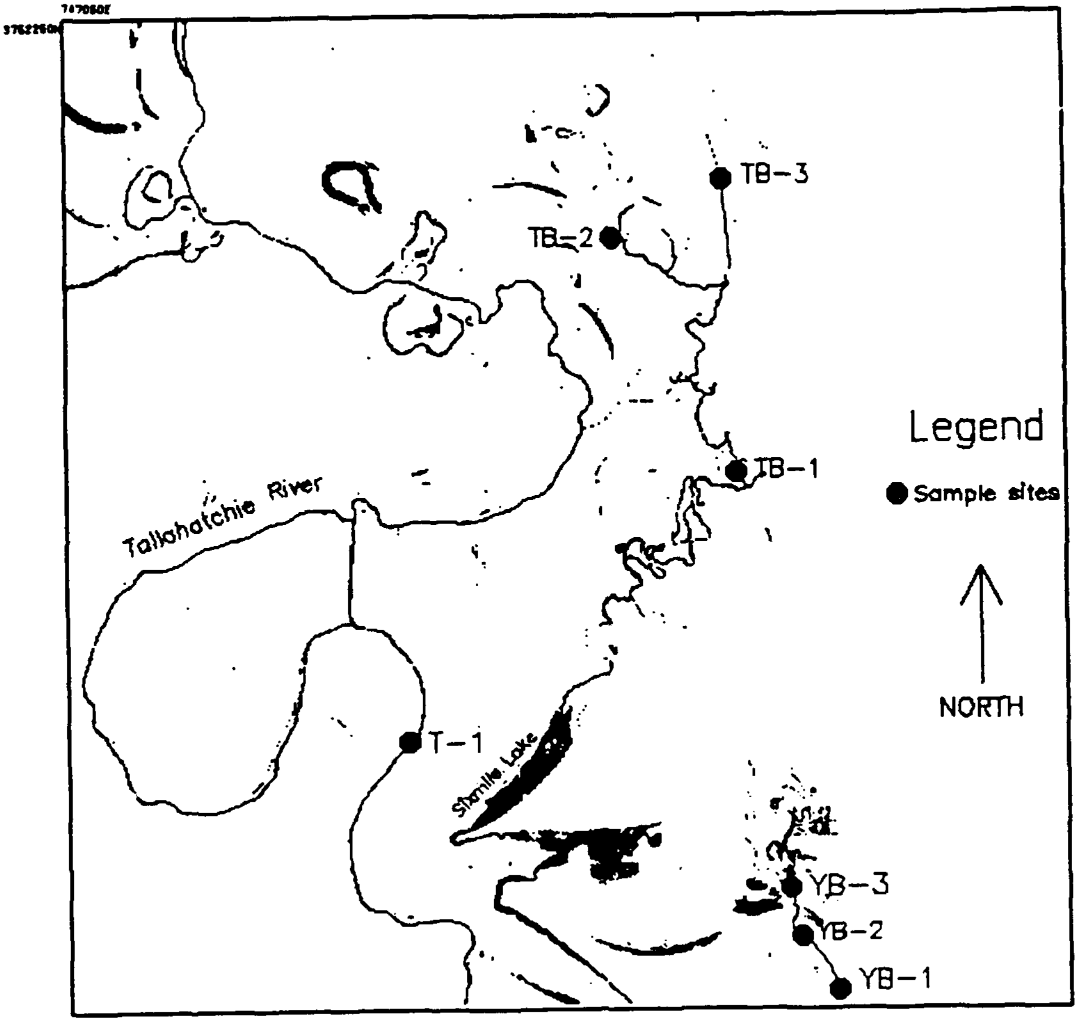
** Lipid data (standard deviation in parentheses) were from Steve Smith, US Fish and Wildlife Service

\+ Concentrations below 0.2 mg/kg were not counted when adding concentrations to determine if the FDA action level for DDT and its metabolites was exceeded.



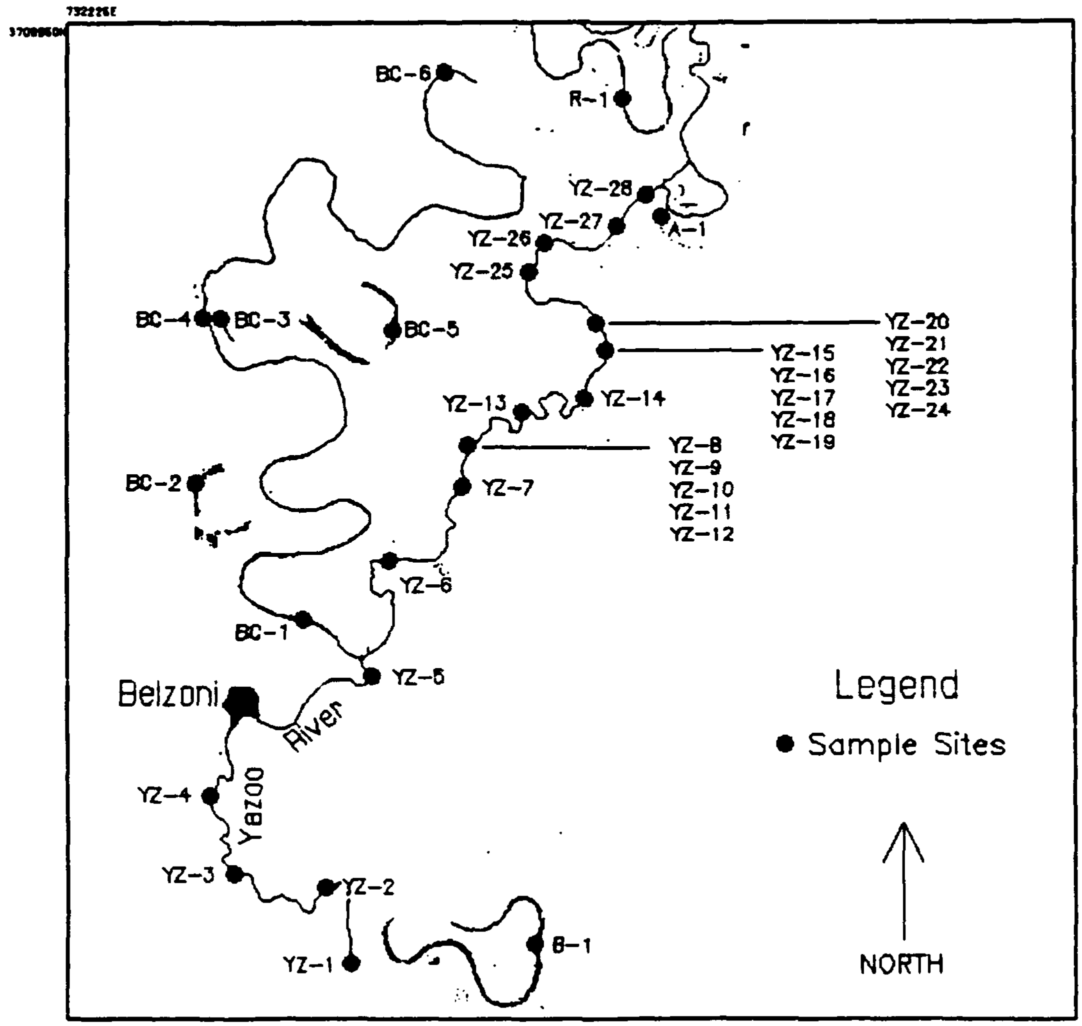
Scale 1 : 120000

Figure IV-1. Locations of sampling stations in the northern portion of the Upper Yazoo Project



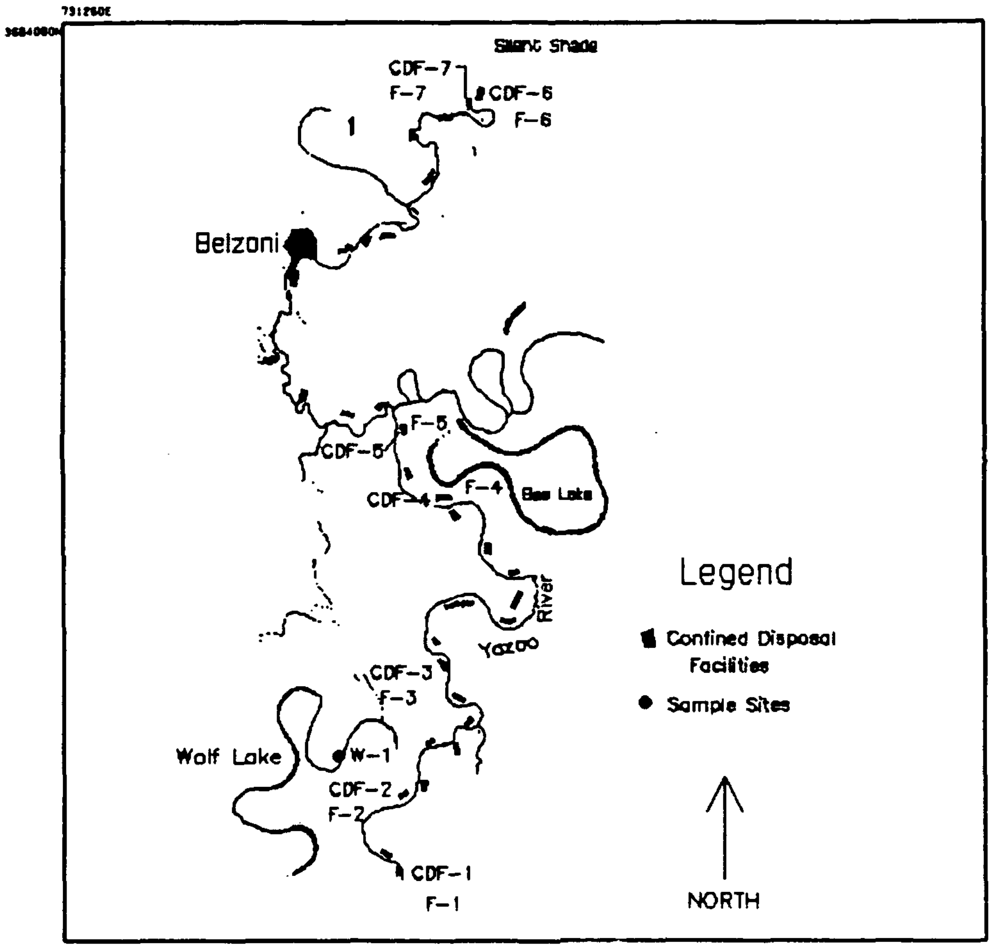
Scale 1 : 175000

Figure IV-2. Locations of sampling stations in the central section of the Upper Yazoo Project



Scale 1 : 300000

Figure IV-3. Locations of sampling stations in the southern section of the Upper Yazoo Project



Scale 1 : 300000

Figure IV-4. Locations of sampling stations for CDF and adjacent field soils samples in the Upper Yazoo Project

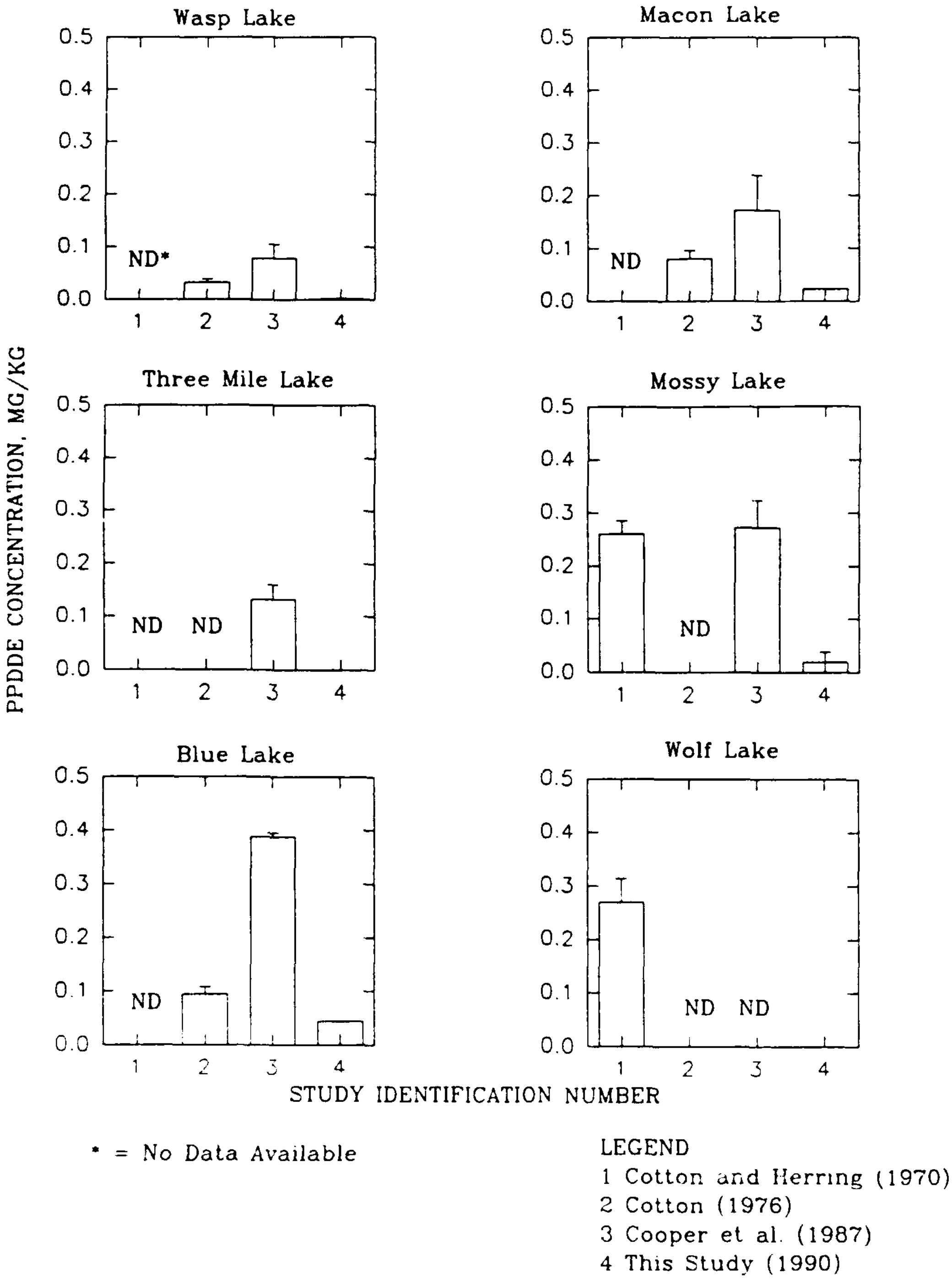


Figure IV-5. PPDDE concentrations (mean and standard error) from historical surface sediment data and recent data (1990) for the Bear Creek area of the Upper Yazoo Project

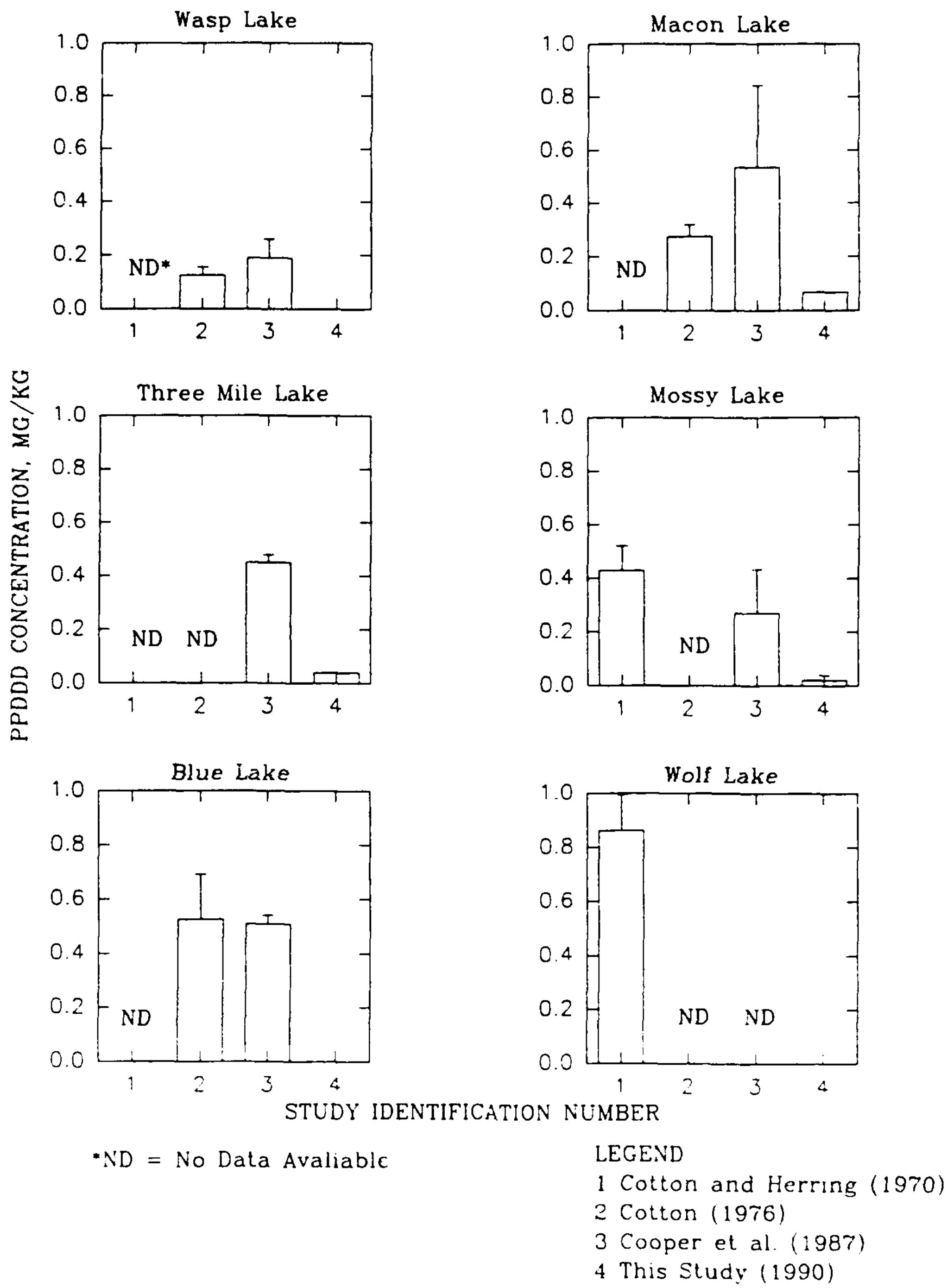


Figure IV-6. PPDDD concentrations (mean and standard error) from historical surface sediment data and recent data (1990) for the Bear Creek area of the Upper Yazoo Project

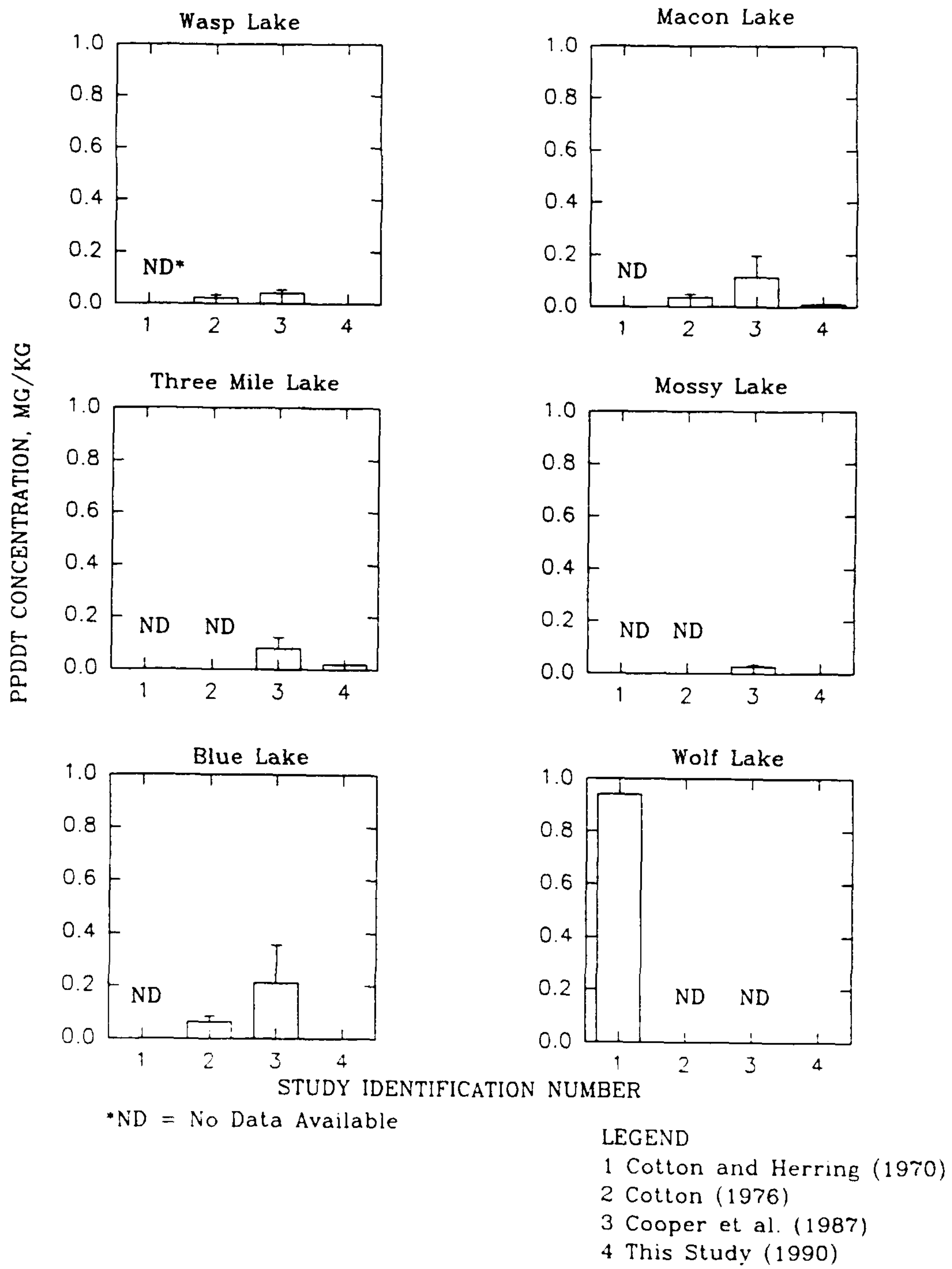


Figure IV-7. PPDDT concentrations (mean and standard error) from historical surface sediment data and recent data (1990) for the Bear Creek area of the Upper Yazoo Project

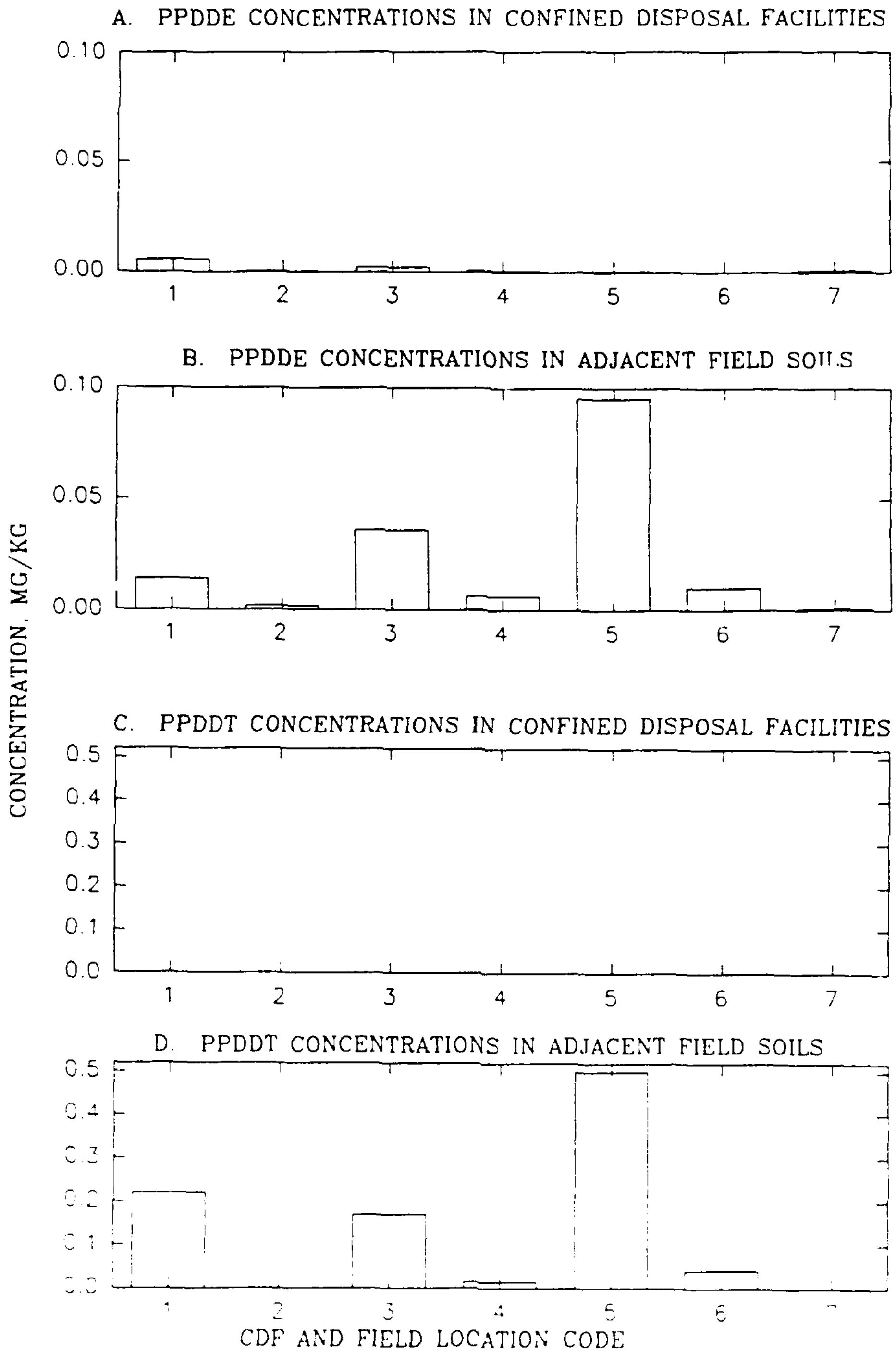


Figure IV-8. Concentrations of PPDDE and PPDDT in confined disposal facilities and adjacent field soils(CDF and F location codes are given in Table IV-2)

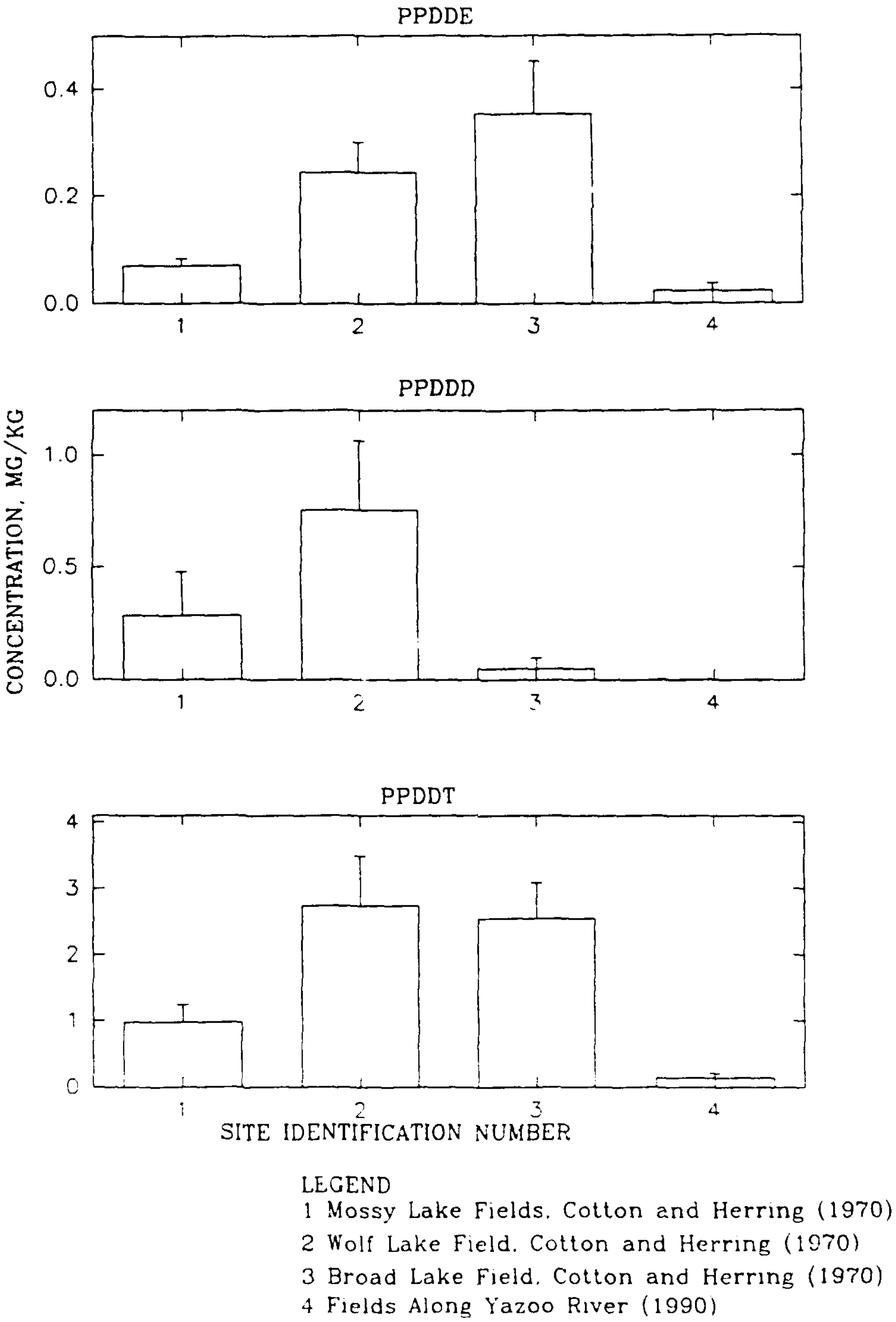


Figure IV-9. Pesticide concentrations (mean and standard error) in field soils adjacent to CDFs (1990) and field soils from the Bear Creek area (1970). The 1990 field soils bar represents the mean of seven sampled fields

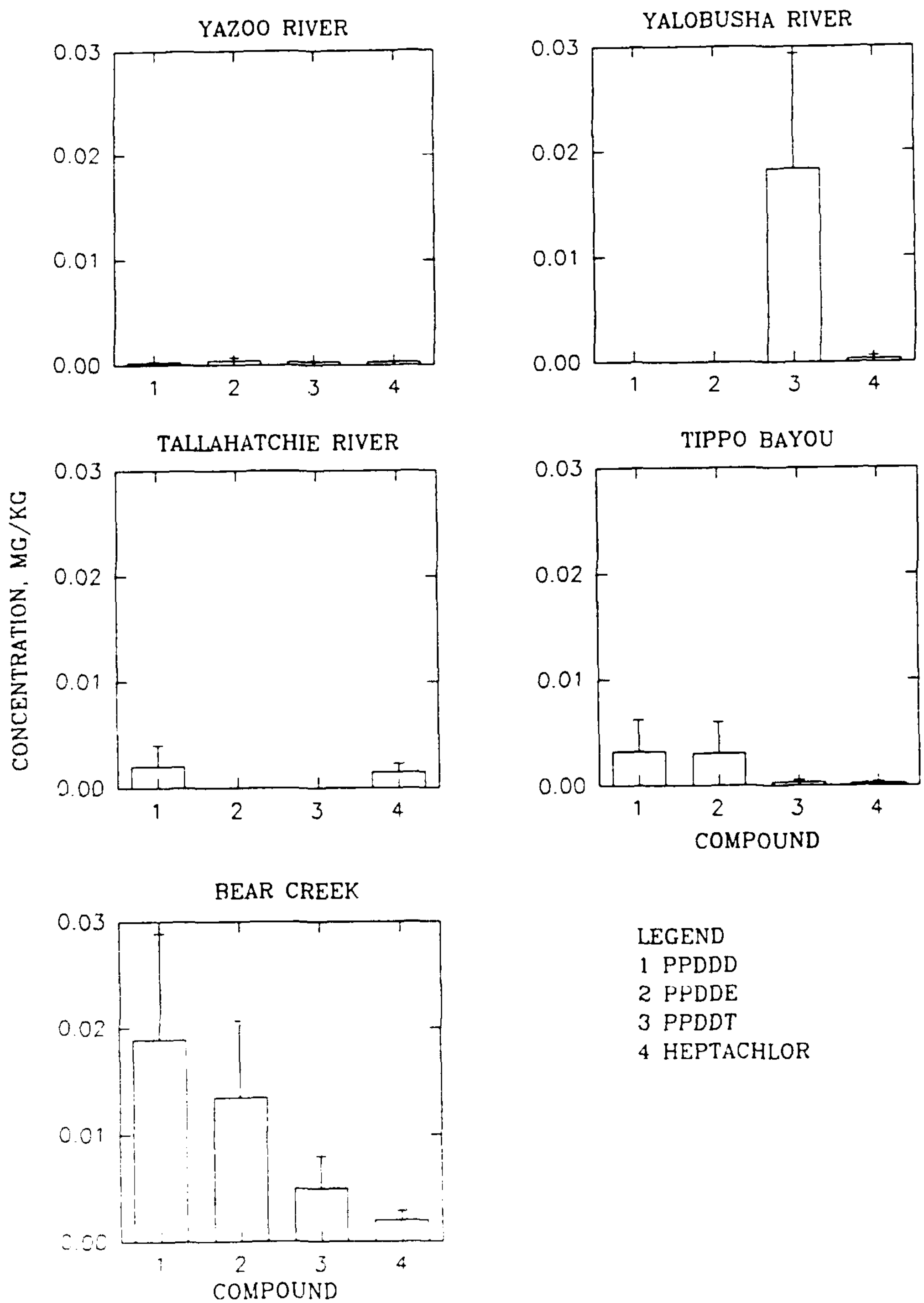


Figure IV-10. Concentrations (mean and standard error) of pesticides in surface sediments in the Upper Yazoo River watershed and its tributaries

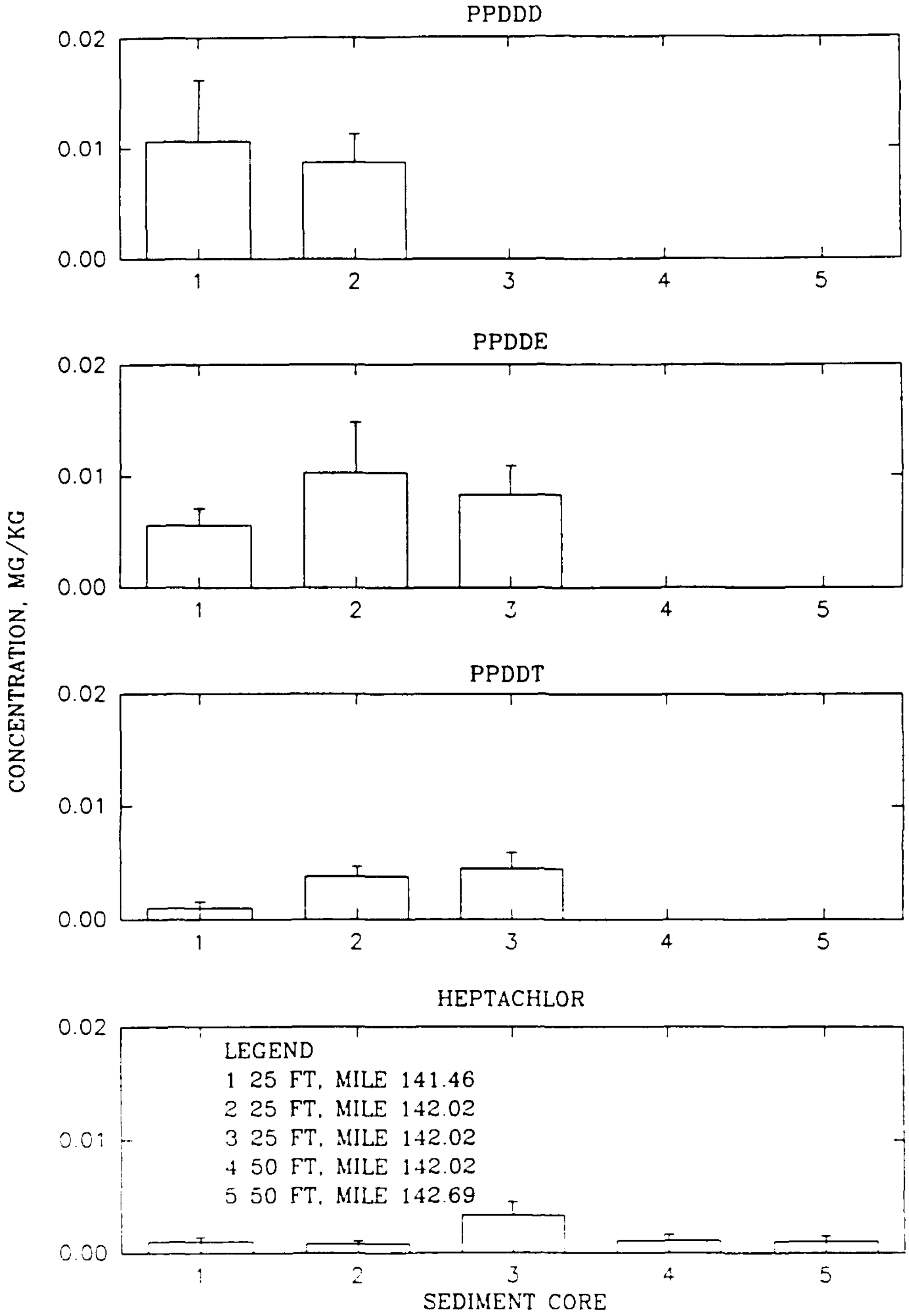


Figure IV-11. Pesticide concentrations (mean and standard error) in five 30-cm core segments from the Yazoo River. Sediment cores 1 through 3 were collected 25 ft from the bank while cores 4 and 5 were collected 50 ft from the bank

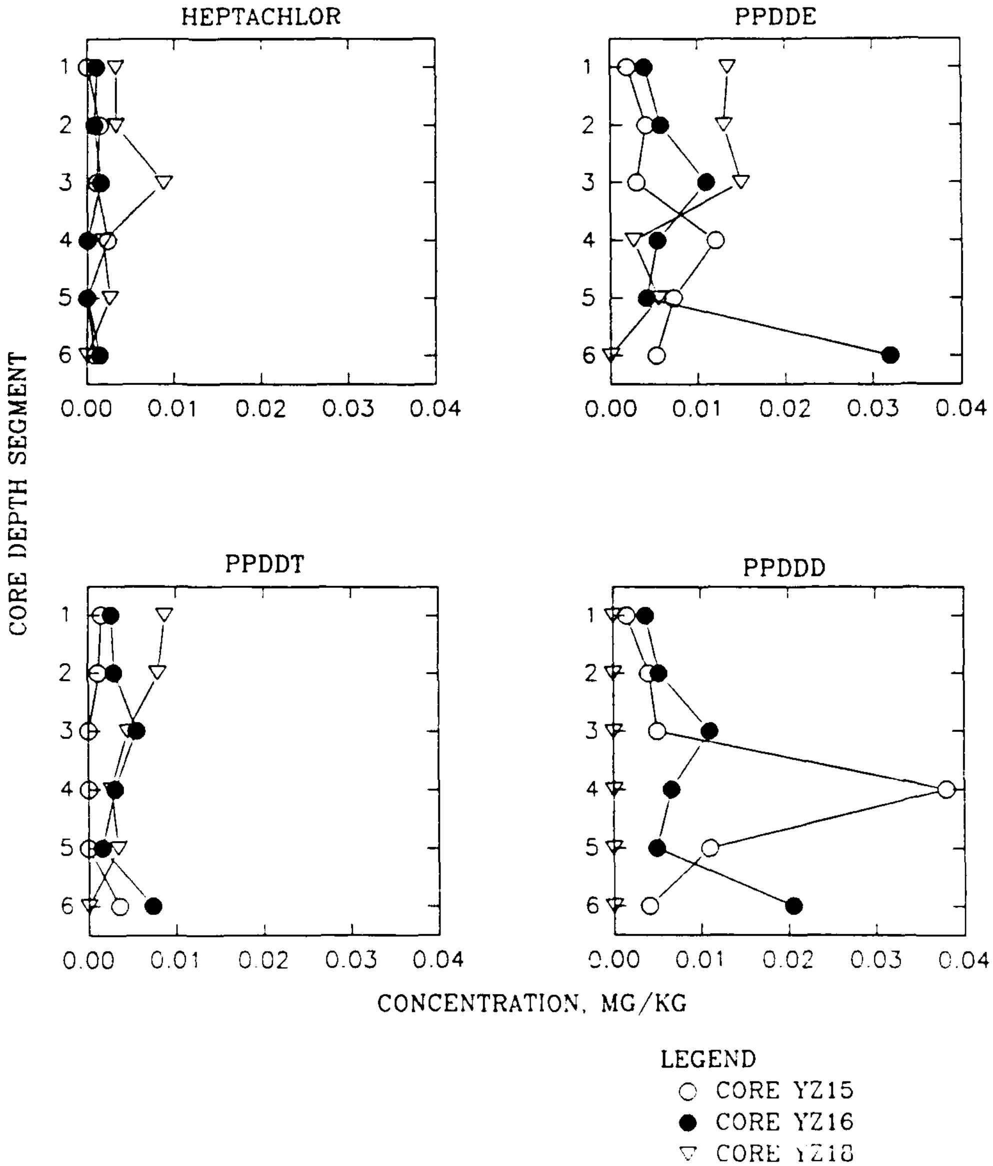


Figure IV-12. Pesticide concentrations with depth in sediment cores taken 25 ft from the banks of the Yazoo River. Each core depth segment is 30 cm

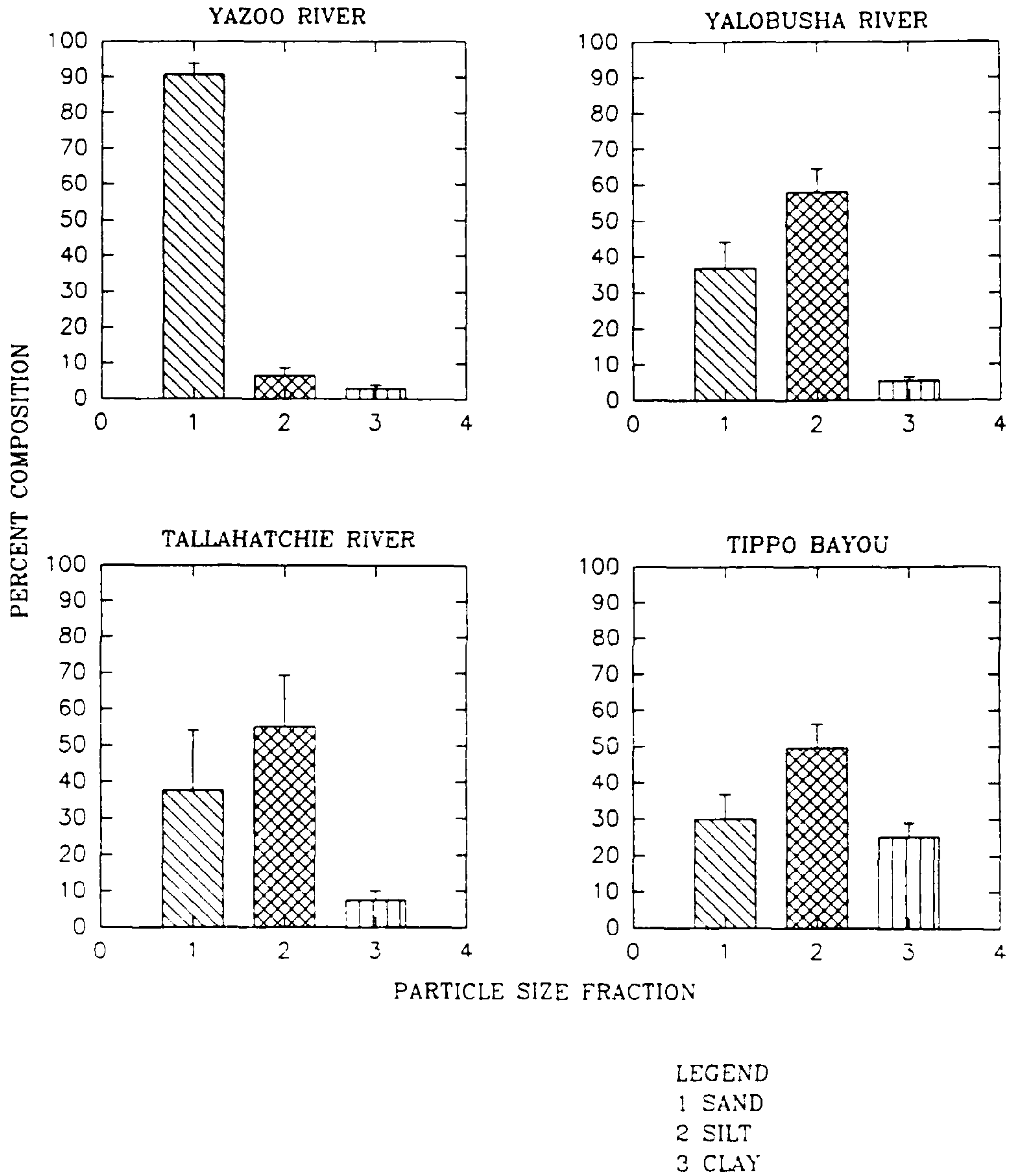


Figure IV-13. Average particle size distribution (mean and standard error) in surface sediment samples from the Yazoo River and its tributaries

PART V: OXBOW LAKES

General Description

Oxbow lakes are the predominant kind of natural lakes in the Delta region. Most are cut-offs created by sluggish meandering streams or abandoned channels of the Yazoo and Mississippi Rivers. Usually, the oxbow lakes of the Yazoo River are fairly productive because of backwater flooding, good water quality, shoreline vegetation, and forest cover.

Over the years water quality of the Delta oxbow lakes has been declining as the result of agricultural practices (Vicksburg District (LMK) 1980, Herring and Cotton 1969). Pesticides, suspended solids (silt), and agricultural chemicals in runoff are the major culprit of the decline in productivity. This is particularly true at lakes that do not receive backwater flooding (LMK 1980).

To assess the water quality and pesticide levels more than a decade after the banning of PPDDT and other chlorinated insecticides, a one-time (baseline) sampling event was conducted. Three oxbow lakes from the UYP area and one just outside the project boundaries were selected (Table V-1 and Figure V-1). Sediment samples were also obtained from these oxbow lakes (Figures IV-1 through IV-4 and Table V-2). Information on sampling and analysis of core and surface sediment samples is presented in Part IV of this report. Water samples were analyzed for conventional pollutants and field parameters (Table II-4) as well as for the insecticides and herbicides (Table II-5). All stations were located at bridges over the lakes.

Water quality and pesticide data in the four oxbow lakes will serve a dual purpose: to provide a baseline or reference for future studies in the Yazoo basin, and to complement fish and invertebrate data collected by other groups. The baseline study will be important where modifications of the Yazoo River will disturb the natural exchange of water between the river and the oxbow lakes.

General Water Quality

Conventional parameters

Only one station, Wolf Lake near Lake City (W1), was below the recommended DO, 5 mg/l, but above the minimum water quality criterion established by the State of Mississippi, 4 mg/l (MDEQ 1990) (Table V-3). Although DO was above the State water quality criterion, DO was below saturation at 15.5 °C. All the lakes but Roebuck (R3) and Alligator Bayou (A) had DO below the minimum water quality criterion at the lower depths (Table V-4). Temperature and conductivity (Table V-4) were fairly uniform with depth in all the lakes. Conductivity was between the recommended 50 to 500 μmhos/cm (Herring and Cotton 1974). The typical pH in natural systems is between 6.5 and 8.5. The lakes showed a much closer range of 6.8 to 7.5.

Several stations received rain during the sampling period. Turbidity was high at Alligator Bayou, Bee Lake, and Wolf Lake (Stations A, B, W1, and W2, respectively). Turbidities over 80 NTUs are considered poor for some freshwater fishes. Suspended solids at Wolf Lake near Lake City (W1) and Alligator Bayou (A) were significantly higher than at the other lakes, probably due to localized runoff (Table V-5). The values at Wolf Lake (W1) and Alligator Bayou agree with suspended solids concentrations at heavily cultivated sites of Bear Creek near McCoy Lake (Station 5a) and Three Mile Lake (Station 7).

<u>Pesticides</u>

Several chlorinated insecticides and two herbicides, TRIFLURA and 2,4,5-T, were detected in the oxbow lakes (Table V-6). Three lake stations showed no pesticides. The herbicide, TRIFLURA, was detected in two lakes, Roebuck (R) and Wolf (W), an indication of the application of pre-emergence herbicides in the watersheds. TRIFLURA, which is used on soybeans and cotton, associates readily with suspended solids because of its low aqueous solubility (less than 1 mg/l). The absence of TRIFLURA in lakes having higher suspended solids concentrations (Alligator Bayou (A) and Wolf Lake near Lake City (W1)) than Roebuck Lake southeast of Itta Bena (R3) and Wolf Lake on Highway 49 (W2) indicates that TRIFLURA was locally applied in the watersheds of Roebuck (R3) and Wolf Lakes (W2).

The organochlorine insecticides, PPDDT, HPTCL, and HPTCLE, were detected at only one station, Wolf Lake near Lake City (W1). High suspended solids in W1 suggest that the source of the pesticide was runoff from agricultural land in the watershed, or resuspension of residues in the sediments. Roebuck Lake east of Itta Bena (R2) showed detectable concentrations of the phenoxyacetic acid herbicide 2,4,5-T and the organochlorine insecticide ENDOSU. Both 2,4,5-T and ENDOSU were present in the Bear Creek study at different times, and 2,4,5-T was present in the October sampling of the Yazoo River. Figure V-2 shows literature values (Cotton and Herring 1970, Bingham 1969, Franks 1981) for Wolf Lake together with results from 1990. The PPDDT concentration in Wolf Lake has decreased from over 500 pptr to near 20 pptr. Values for 1981 appear lower than those for 1990, but the difference may be due to different detection limits.

In addition to the pesticides in Table II-5, water samples were collected at si.. lakes and analyzed by the USGS laboratory for triazine and chloroacetanilide herbicides (Table V-7). Unlike the organochlorine insecticides, the triazine and chloroacetanilide herbicides are transported in the dissolved phase (99.5%) and less than 0.5% in the suspended or adsorbed phase (Pereira and Rostad 1990, Ruiz 1979). These herbicides are usually present in the runoff (sometimes at high concentration) immediately following application to crops. Their persistence in the aquatic environment is short lived due to their rapid degradation and/or breakdown, but their toxicity to aquatic organism is much lower than either the organochlorine and organophosphorus insecticides.

The biomagnification/bioaccumulation potential of these herbicides is orders of magnitude lower than those of PPDDT and similar compounds. Partition coefficients normalized to the organic carbon content of the sample, K_{oc}, are from 100 to 200 for these herbicides (*Pereira and Rostad* 1990) versus 238,000 for PPDDT (Lyman et al. 1982). Therefore, the estimated bioconcentration factors (BCF) range between 5 and 10 for these herbicides as compared to 27,000 for PPDDT (Lyman et al. 1982).

Table V-7 shows currently used herbicides in the oxbow lakes and Wasp Lake in Bear Creek. Metribuzin was detected in all the lakes. The highest concentration of any herbicide was 7.2 ppb Atrazine in Wolf Lake near Lake City (W1). Wolf Lake exhibited the largest number (five) of different herbicides present in the surface water samples and the highest concentration of each of the herbicides. Herbicides values for Atrazine, Cyanazine, Methoalachlor, and Simazine in Table V-7 are higher than those reported by Pereira and Rostad 1990 (0.229 ppb Atrazine, 0.017 ppb Cyanazine, 0.097 ppb Methoalachlor, 0.006 ppb Simazine) for the Yazoo River near Vicksburg (at mile 10). Dilution and, to some extent, degradation occurring in the Yazoo River near Vicksburg account for lower values than found in lakes and creeks draining primarily agricultural land.

Sediments

PPDDT, PPDDD, PPDDE, HPTCL, ENDOI, ENDOSU, and methoxychlor (METOXYCL) were detected in the surface sediment of Bee Lake (B1), but no pesticides were detected in surface sediments in Wolf Lake (W1) (Table V-8). Residue concentrations in Bee Lake ranged from 0.0089 to 0.0260 mg/kg. Concentrations of PPDDE, PPDDD, and PPDDT in Wolf Lake reported by Cotton and Herring (1970) were substantially higher than those found in either surface sediments or cores in 1990 (Table V-8 and Figures IV-5 through IV-7). TOXAPHEN concentrations measured in this study were also substantially lower than the concentrations reported by Cotton and Herring (1970) (3.0 to 3.86 mg/kg).

Chlorinated insecticides were below detection limits in the first segments (depth 1) of cores from Wolf, Alligator, and Roebuck Lakes (Table V-9). PPDDT was below detection limits throughout the sediment profile of all three lakes. Chlorinated insecticides were detected sporadically in the remaining depth segments of sediment cores from the oxbow lakes, but the great majority were below detection limits.

Most sediments in the oxbow lakes were fine-grained material, with the exception of Roebuck Lake, which was predominantly sand (Table V-10). Sand comprised from 62.5% to 72.5% of the first three depth segments (first 30 cm) in Roebuck Lake (R1), while the remaining lower depth segments were composed mainly of fine-grained material. Wolf (W1) and Alligator Lakes (A1) cores were fine-grained material.

Table V-1

Oxbow Lakes Sampling Stations

Station	Lake	Description
R1	Roebuck	Bridge across Roebuck Lake near Itta Bena
R2	Roebuck	Bridge across Roebuck Lake (culvert) 1 mile east of Itta Bena
R3	Roebuck	Bridge across Roebuck Lake four miles southeast of Itta Bena
A	Alligator	Bridge across Alligator Bayou, on road to Sidon
B	Bee	Bridge across Bee Lake, near Sweet Kingdom Church
W1	Wolf	Bridge across Wolf Lake, near Lake City
W2	Wolf	Bridge across Wolf Lake, on Highway 49

Table V-2

Locations and Site Descriptions of Sampling Stations in Oxbow Lakes

Station	UTM COORDINATES* (X,Y)		Sample Type**
	X	Y	
Bee Lake - in Holmes county near Silver City (B1)	749382	3661593	S
Roebuck Lake - in Leflore county near Itta Bena (R1)	754112	3704963	C
Alligator Lake - in Leflore county near Sidon (A1)	755983	3699019	C
Wolf Lake - in Yazoo county near Yazoo City (W1)	73[illegible]	3645661	S and C

* Universal Transverse Mercator, Zone 15.

** S indicates surface sediment sample; C indicates sediment core.

Table V-3

Surface Water Quality in Oxbow Lakes - Field Data, May 31, 1990

Station	Temp (°C)	DO (mg/l)	pH	Cond (μmhos/cm)	Turb (NTU)	Barometer (mm of Hg)
R1	23.5	6.9	7	66	23	757
R2	23.0	5.1	7	61	50	757
R3	24.0	6.8	6.8	66	50	757
A	23.5	6.1	6.8	103	75	757
B	23.5	6.7	7.1	69	100	757
W1	22.5	4.7	7.2	100	100	757
W2	23.5	5.2	7.5	121	75	757

Table V-4

Water Quality in Oxbow Lakes - Field Data with Depth, May 31, 1990

Station	Time	Depth (ft)	pH	Cond (μmhos/cm)	Temp (°C)	DO (mg/l)
R1	9:26	1.0	7.0	66	23.5	6.9
R1	9:27	7.0	6.8	69	23.5	3.0
R3	11:01	1.0	6.8	66	24.0	6.8
R3	11:02	3.0	6.8	66	24.0	5.9
A	12:31	1.0	6.8	103	23.5	6.1
A	12:32	6.1	6.8	103	23.5	5.6
B	13.46	1.0	7.0	69	23.5	6.7
B	13:47	9.0	7.1	76	23.0	1.4
W1	15:01	1.0	7.2	100	22.5	4.7
W1	15:02	4.0	7.4	95	22.5	3.4
W2	15:31	1.0	7.5	121	23.5	5.2
W2	15:32	11.0	7.2	128	22.5	0.3

Table V-5

Water Quality in Oxbow Lakes - Laboratory Analysis, May 31, 1990

Station	TS (mg/l)	TSS (mg/l)	Chla* (mg/l)	TOC (mg/l)	DOC (mg/l)	ON (mg/l)	NO^3/NO^2-N (mg/l)	NH^3-N (mg/l)	TP (mg/l)	TDP (mg/l)
R1	90	27	0.00526	4.1	3.6	0.88	0.08	0.02	0.15	0.06
R2	98	37	0.00798	4.4	3.6	0.99	0.09	0.01	0.20	0.04
R3	145	45	0.01074	4.1	3.6	0.94	0.26	0.06	0.24	0.06
A	225	123	0.00668	4.7	4.2	1.04	0.24	0.06	0.30	0.05
B	238	57	0.00223	4.4	4.1	1.03	0.53	0.07	0.28	0.06
W1	353	209	0.00523	6.5	6.2	1.90	1.10	0.40	0.40	0.06
W2	242	49	0.00373	6.9	6.4	1.27	0.88	0.13	0.29	0.08

* Chlorophyll *a* corrected for phaeophytin.

Table V-6

TOC and Pesticides in Surface Waters of Oxbow Lakes, May 31, 1990

Station	TOC (mg/l)	PPDDT (mg/l)	HPTCL (mg/l)	HPTCLE (mg/l)	TRIFLURA (mg/l)	2,4,5-T (mg/l)	ENDOSU (mg/l)
R1	4.1	<0.00001	<0.00001	<0.00001	<0.00001	<0.0008	<0.00001
R2	4.4	<0.00001	<0.00001	<0.00001	<0.00001	**0.0011**	**0.00002**
R3	4.1	<0.00001	<0.00001	<0.00001	**0.00003**	<0.0008	<0.00001
A	4.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.0008	<0.00001
B	4.4	<0.00001	<0.00001	<0.00001	<0.00001	<0.0008	<0.00001
W1	6.5	**0.00002**	**0.00003**	**0.00003**	<0.00001	<0.0008	<0.00001
W2	6.9	<0.00001	<0.00001	<0.00001	**0.00002**	<0.0008	<0.00001

Table V-7

Currently Used Herbicides - Oxbow Lakes, May 31, 1990

Station	Alachlor Total Recover (mg/l)	Ametryne Total (mg/l)	Atrazine Total (mg/l)	Cyanazine Total (mg/l)	Methoalachlor Total Recover (mg/l)	Metribuzin Total Recover (mg/l)	Prometone Total (mg/l)	Prometryne Total (mg/l)	Propazine Total (mg/l)	Simazine Total (mg/l)	Simetryne Total (mg/l)	TRIFLURA Total Recover (mg/l)
R1	<0.0001	<0.0001	<0.0001	0.0004	0.0019	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
A	<0.0001	<0.0001	0.0004	<0.0001	0.0004	0.0002	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
B	<0.0001	<0.0001	0.0001	0.0008	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
W1	<0.0001	<0.0001	0.0072	0.0009	0.0052	0.0023	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001
W2	<0.0001	<0.0001	0.0044	0.0004	0.0036	0.0003	<0.0001	<0.0001	<0.0001	0.0011	<0.0001	<0.0001
Wasp Lake	<0.0001	<0.0001	0.0003	0.0003	0.0026	0.0010	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table V-8

Chemical Analyses of Surface Sediments from Oxbow Lakes in the Upper Yazoo Project Area

Station	TOC (mg/kg)	PPDDD (mg/kg)	PPDDE (mg/kg)	PPDDT (mg/kg)	HPTCL (mg/kg)	ENDOI (mg/kg)	ENDOSU (mg/kg)	METOXCYL (mg/kg)
B1	16489	.0240	.0260	.0089	.0020	.0025	.0043	.0071
W1	28470	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002

Table V-9

Chemical Analyses of Core Sediments from Oxbow Lakes in the Upper Yazoo Project Area

		Parameters				
Station	Depth	TOC (mg/kg)	PPDDD (mg/kg)	PPDDE (mg/kg)	PPDDT (mg/kg)	HPTCL (mg/kg)
W1	1	28470	<.0002	<.0002	<.0002	<.0002
	2	18940	**.0740**	<.0002	<.0002	<.0002
	3	5790	<.0002	<.0002	<.0002	<.0002
	4	4520	<.0002	<.0002	<.0002	<.0002
	5	520	<.0002	<.0002	<.0002	<.0002
A1	1	5130	<.0002	<.0002	<.0180	<.0002
	2	4690	<.0002	<.0002	**.0053**	<.0002
	3	3960	<.0002	<.0002	<.0002	**.0008**
	4	2490	<.0002	**.0005**	<.0002	<.0002
	5	3990	<.0002	<.0002	<.0002	**.0020**
R1	1	18760	<.0002	<.0002	<.0002	<.0002
	2	13660	<.0002	<.0002	<.0002	<.0002
	3	19430	<.0002	**.1500**	<.0002	<.0002
	4	12620	<.0002	<.0002	<.0002	<.0002
	5	16550	<.0002	<.0002	<.0002	<.0002
	6	7450	<.0002	<.0002	<.0002	<.0002

Table V-10

Particle Size Distribution in Surface and Core Sediment Samples from Oxbow Lakes

Station	Depth (ft)	% Clay	% Silt	% Sand
B1	S*	45.0	50.0	5.0
R1	S	20.0	7.5	72.5
A1	S	35.0	42.5	22.5
W1	S	50.0	50.0	0.0
R1	1	20.0	7.5	72.5
	2	17.5	15.0	67.5
	3	20.0	17.5	62.5
	4	27.5	25.0	47.5
	5	47.5	27.5	25.0
	6	32.5	45.0	22.5
W1	1	40.0	27.5	32.5
	2	45.0	27.5	27.5
	3	47.5	30.0	22.5
	4	45.0	30.0	25.0
	5	42.5	27.5	30.0
A1	1	35.0	42.5	22.5
	2	32.5	50.0	17.5
	3	32.5	60.0	7.5
	4	25.0	62.5	12.5
	5	20.0	65.0	15.0

* Surface sediment sample.

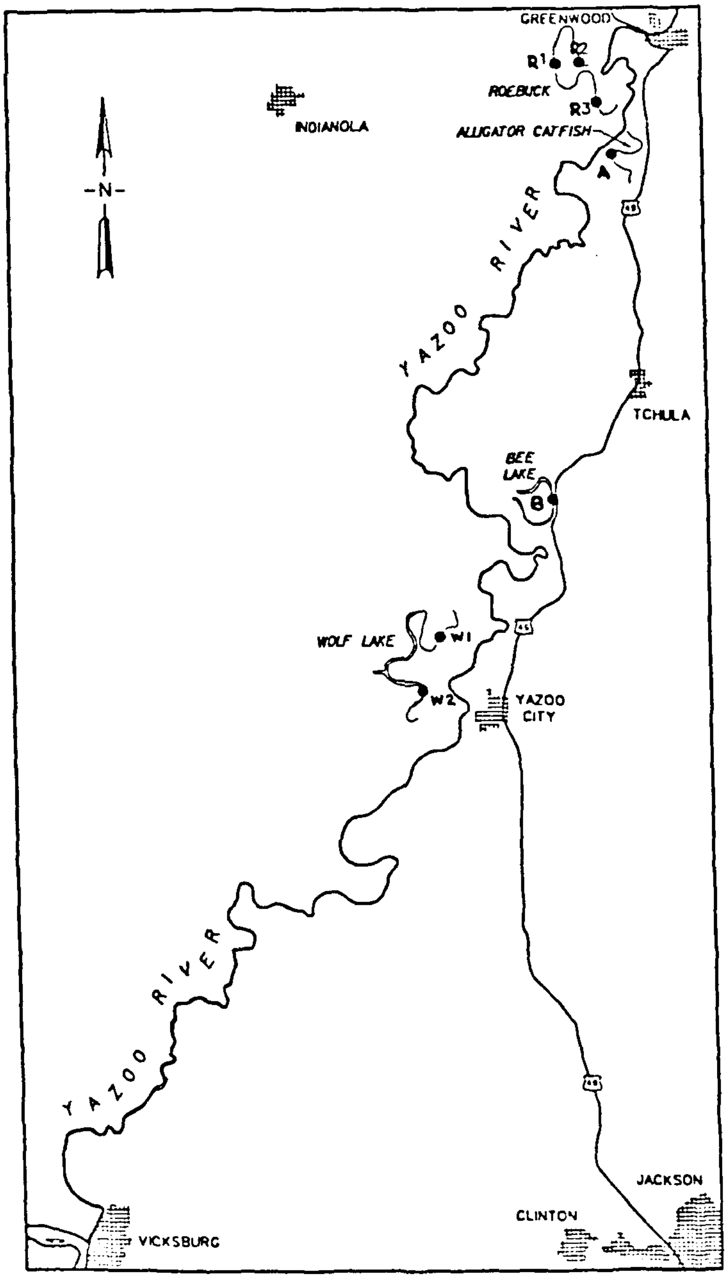


Figure V-1. Oxbow lakes sampling sites

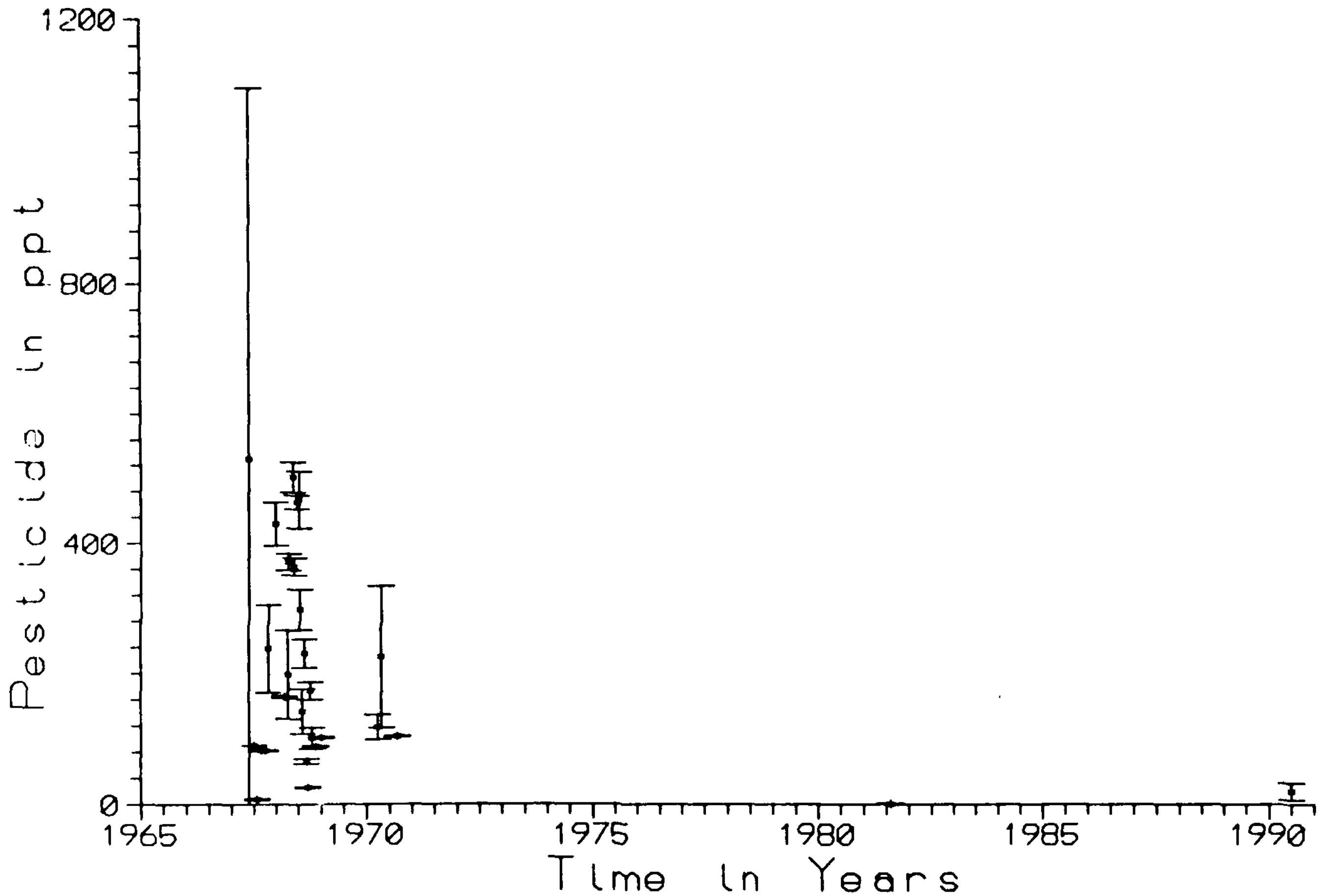


Figure V-2. Temporal distribution of PPDDT in Wolf Lake surface water based on historical data (Cotton and Herring 1970, Bingham 1969, Franks 1981) and 1990 data.

PART VI: COMPARISON OF WATER QUALITY IN UYP

Bear Creek watershed is typical of the delta region within the UYP. The average slope along Bear Creek (0.5 ft/mile) is similar to that of the remainder of the delta region. Erosion rates for Bear Creek watershed vary from 2 to 5 tons/acre per year. These rates are within the range of 2 to 6 tons/acre per year reported for the delta as a whole (LMK 1980). Over 73 percent of land within the Bear Creek watershed is used for agriculture. This figure is similar to that of other watersheds within the Delta. For example, 70 percent of the Tippo Bayou watershed that is located in the central portion of the Delta and the upper portion of the UYP is used for agriculture (LMK 1973).

Comparisons of selected water quality and pesticide data for Bear Creek and other water bodies throughout the UYP (Table VI-1) are shown in Figures VI-1 through VI-4. These water bodies were selected for comparison based on their location within and in relation to the UYP and availability of data. Although flow and certain other characteristics of these water bodies are not necessarily the same as those of the Bear Creek watershed, all are subjected to the same topography and land use.

Description of Water Bodies Used in Comparison

The Coldwater River is the headwaters and outlet for Arkabutla Lake, which is located just north of the UYP boundary but still within the Delta. The Coldwater River flows southward and enters the UYP area joining the Tallahatchie River just above Cowart, MS. The Coldwater River was sampled at Prichard, MS, which is approximately 8 miles below the outfall for Arkabutla Lake and just north of the UYP boundary.

Data for the Tallahatchie River are from a station at Swan Lake, MS. The Tallahatchie River is the outfall for Sardis Lake, which is located northwest of Oxford, MS. Both Arkabutla and Sardis lakes are reservoirs operated by the Corps of Engineers.

The Sunflower River is located in the western portion of the Delta and joins the Yazoo River just below Satartia, MS. Data for the Sunflower River were collected at Sunflower, MS.

Two stations on the Yazoo River, Shell Bluff and Redwood, were also used in this comparison. The Shell Bluff station was sampled during 1990 as part of this study, and the results of that sampling are discussed in Part II. The station at Redwood is located south of the UYP boundary, below the confluence of the Sunflower River with the Yazoo.

Comparisons of Data

Data for the Coldwater, Tallahatchie, and Sunflower Rivers were obtained from STORET, while data for Steele Bayou were from a recent study (Ashby et al. 1991). Data for Bear Creek consisted of data collected for this study and in the earlier USDA study (USDA 1976a-b, USDA 1977a-d, USDA 1978a-d, USDA 1979a-d). As shown in Figures VI-1 through VI-3, the record is incomplete in terms of constituents sampled and duration of sampling. The most complete records are for TSS and NO_3/NO_2-N. Pesticide data for the rivers were found only for the years 1975 through 1977, and no DO data were found for these stations.

The major difference in TSS concentrations for these water bodies was the magnitude of peak values. The highest TSS concentrations observed in these water bodies since 1975 were in the Coldwater, Sunflower, and Tallahatchie Rivers (Figure VI-1). The high values had a short duration, indicating probable association with a runoff or flood event. At other times, TSS concentrations in these rivers were similar to TSS concentrations observed in the Bear Creek and Steele Bayou watersheds in 1990. The records for these watersheds are not as complete as those of the rivers. As indicated in Part II of this report, some of the differences in the data for the Bear Creek watershed from the 1976 to 1979 USDA study (USDA 1976a-b, USDA 1977a-d, USDA 1978a-d, USDA 1979a-d) and the data collected in 1990 are attributable to sampling frequency differences and the effects of the Wasp Lake control structure.

The TSS concentrations for stations on the Yazoo River at Shell Bluff (river mile 150) and Redwood (river mile 17) are also included in Figure VI-1. Both of the stations on the Yazoo River had short periods of high TSS concentrations similar to those of the Coldwater, Sunflower, and Tallahatchie Rivers. The Yazoo River stations were not sampled as regularly as the stations on the Coldwater, Sunflower, or Tallahatchie Rivers. Infrequent sampling is probably one reason that high TSS concentrations observed at the upstream Shell Bluff station were not observed at some later time at the downstream Redwood station. The flows with high TSS concentrations passed the Redwood station in between samplings and were missed.

The DO data for Bear Creek and Steele Bayou watersheds and the Yazoo River are shown in Figure VI-2. No DO data were contained in STORET for the Coldwater, Sunflower, or Tallahatchie Rivers. DO data from the stations in the Bear Creek watershed for 1990 were generally lower than those of the Steel Bayou watershed. The variation in DO with time at the Steele Bayou stations was greater than that observed for the stations in the Bear Creek watershed. Variations of similar magnitude and duration as those observed in Steele Bayou in 1990 and 1991 were recorded during the 1976-79 USDA study on Bear Creek (USDA 1976a-b, USDA 1977a-d, USDA 1978a-d, USDA 1979a-d). DO concentrations in Steele Bayou during 1990 and 1991 were similar to the range of values observed at the two Yazoo River stations.

The NO_3/NO_2-N data (Figure VI-3) indicated that, during 1990, concentrations in the Bear Creek watershed and the Coldwater, Sunflower, and Tallahatchie Rivers were slightly less than those observed in the Steele Bayou watershed. Pre-1990 data for these rivers indicated that short-duration periods of elevated NO_3/NO_2-N levels were observed periodically. The highest concentration observed was 53 mg/l in 1988 on the Coldwater River. However, no other observations greater than 8 mg/l were recorded. Most observations in both watersheds and the rivers were less than 2 mg/l.

Figure VI-4 shows data for the pesticide TOXAPHEN. This pesticide was selected for comparison among water bodies based on abundance of data. Measurements of TOXAPHEN concentrations were obtained in the Coldwater, Sunflower, and Tallahatchie Rivers in 1975, 1976, and 1977.

The highest TOXAPHEN concentration was 1.60 μg/l in the Sunflower River in 1975. All of the remaining samples for which TOXAPHEN concentrations were measured were higher than the detection limit (STORET data qualification code K). In these instances, concentrations were greater than either 0.1 or 0.25 μg/l, which are the values plotted on the graphs for these three rivers. The true TOXAPHEN concentrations were above these values. The highest TOXAPHEN concentration measured in the Bear Creek watershed was 232 μg/l at Macon Lake (Station 7) in 1976. For the Bear Creek stations, all samples that had TOXAPHEN concentrations below detection limits are plotted on the x-axis (0.009 ppb). In 1990, TOXAPHEN levels at these three Bear Creek watershed stations were below detection limits.

Table VI-1

Water Bodies for Which Water Quality and Pesticide Data Were Compared

Water Body	Sampling Location	Sampling Dates
Coldwater River	Prichard, MS	1975 - present
Sunflower River	Sunflower, MS	1975 - present
Tallahatchie River	Swan Lake, MS	1975 - present
Yazoo River	Shell Bluff, MS	1975 - 1986, 1990
Yazoo River	Redwood, MS	1978 - 1990
Steele Bayou Watershed	Black Bayou	1990 - 1991
	Main Canal	1990 - 1991
	Steele Bayou	1990 - 1991
Bear Creek Watershed	Bear Creek near Morgan City (Station 4)	1976 - 1979, 1990
	Mossy Lake (Station 6)	1977 - 1979, 1990
	Macon Lake (Station 7)	1976 - 1979, 1990
	Three Mile Lake (Station 8)	1976 - 1979, 1990
	Six Mile Lake (Station 9)	1976 - 1979, 1990
	Wasp Lake (Station 11)	1976 - 1979, 1990

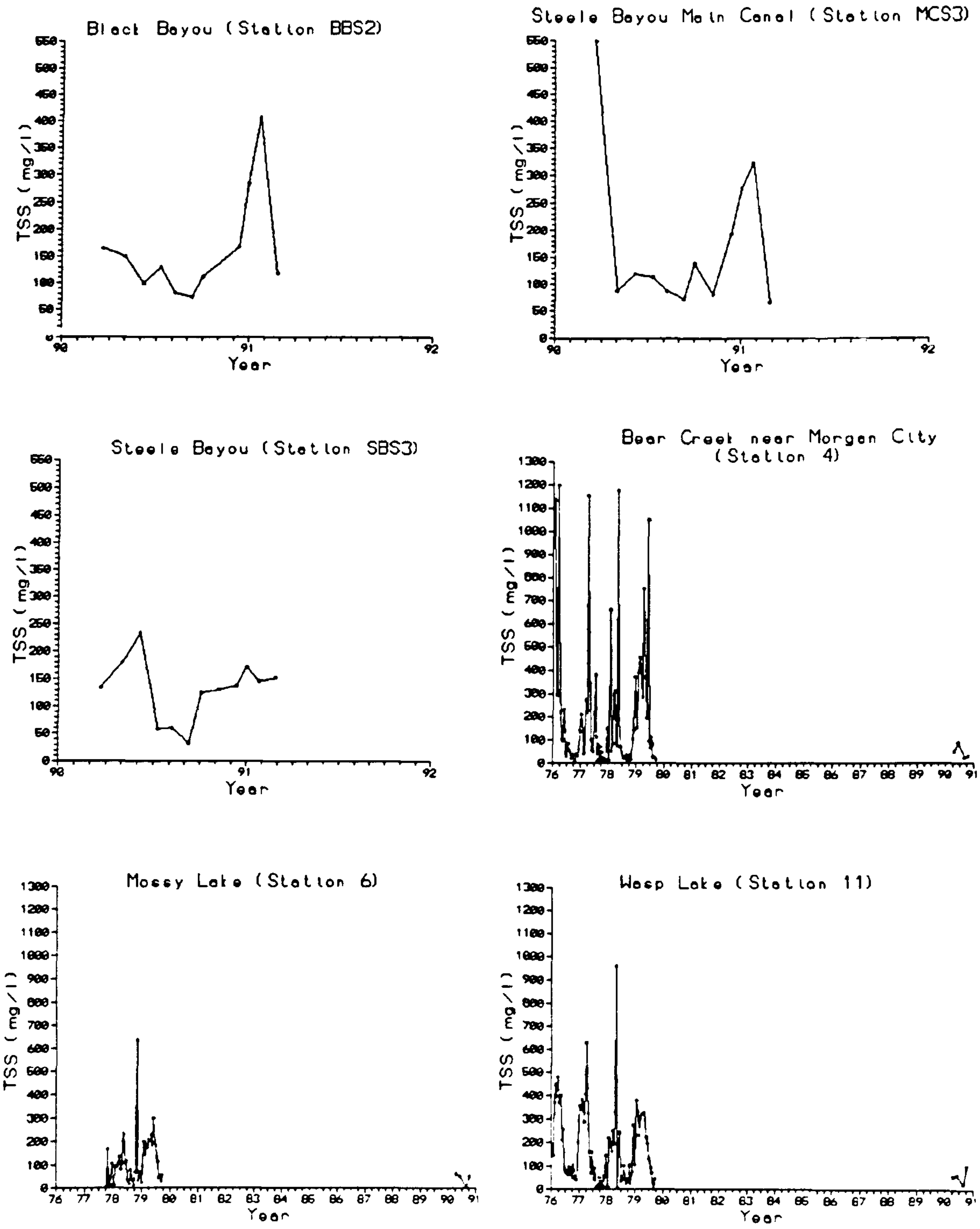


Figure VI-1. TSS for selected UYP water bodies (Continued)

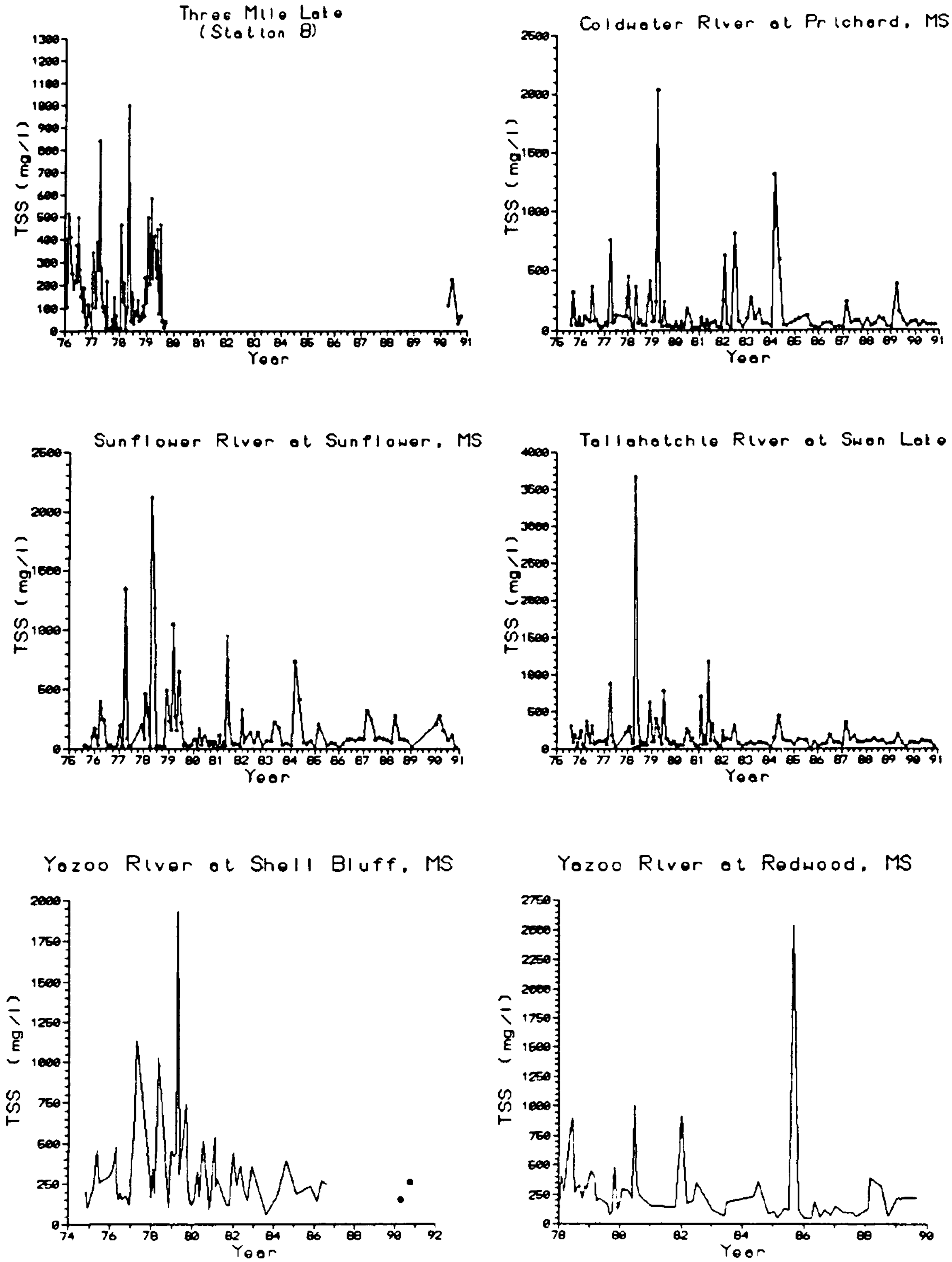


Figure VI-1. (Concluded)

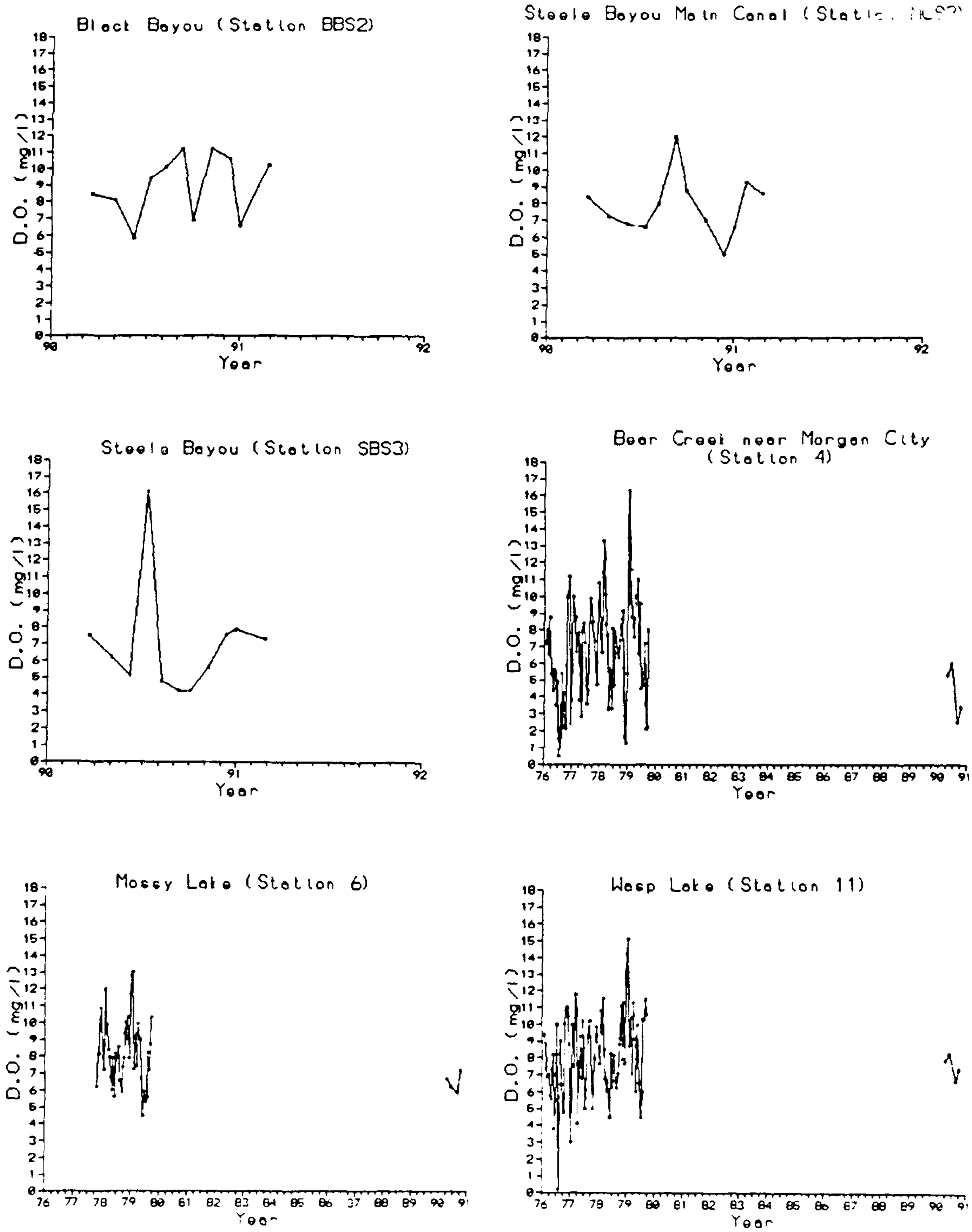


Figure VI-2. DO for selected UYP water bodies (Continued)

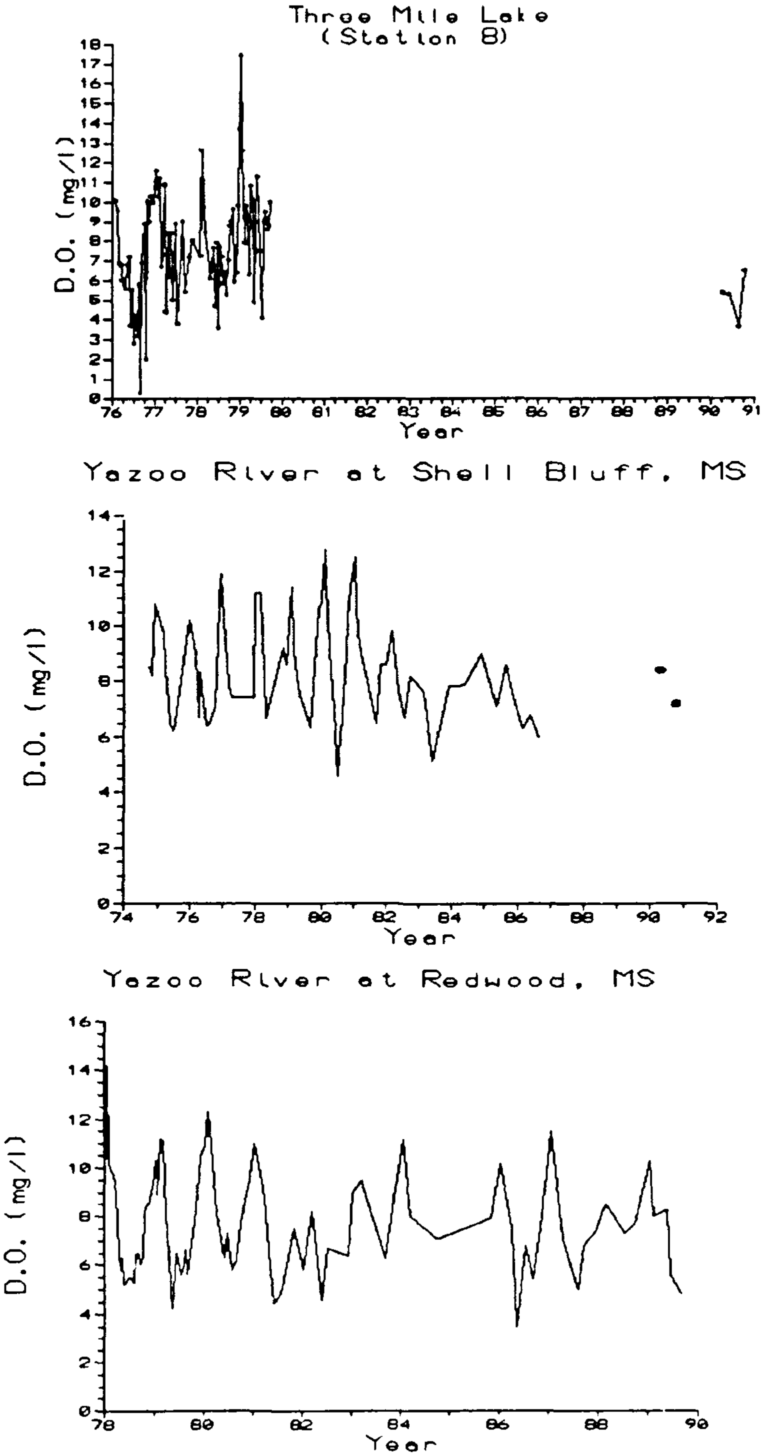


Figure VI-2. (Concluded)

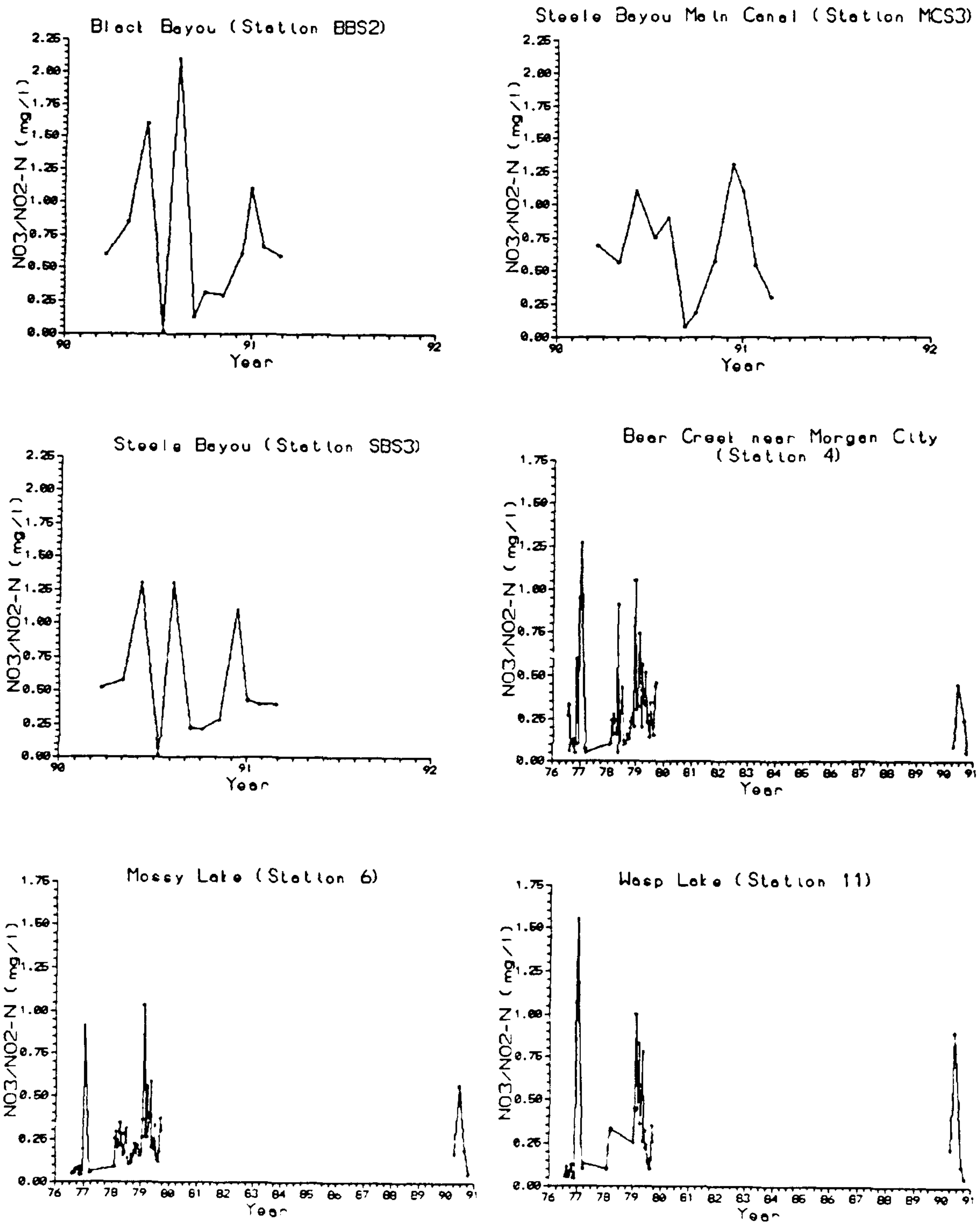


Figure VI-3. NO_3/NO_2-N for selected UYP water bodies (Continued)

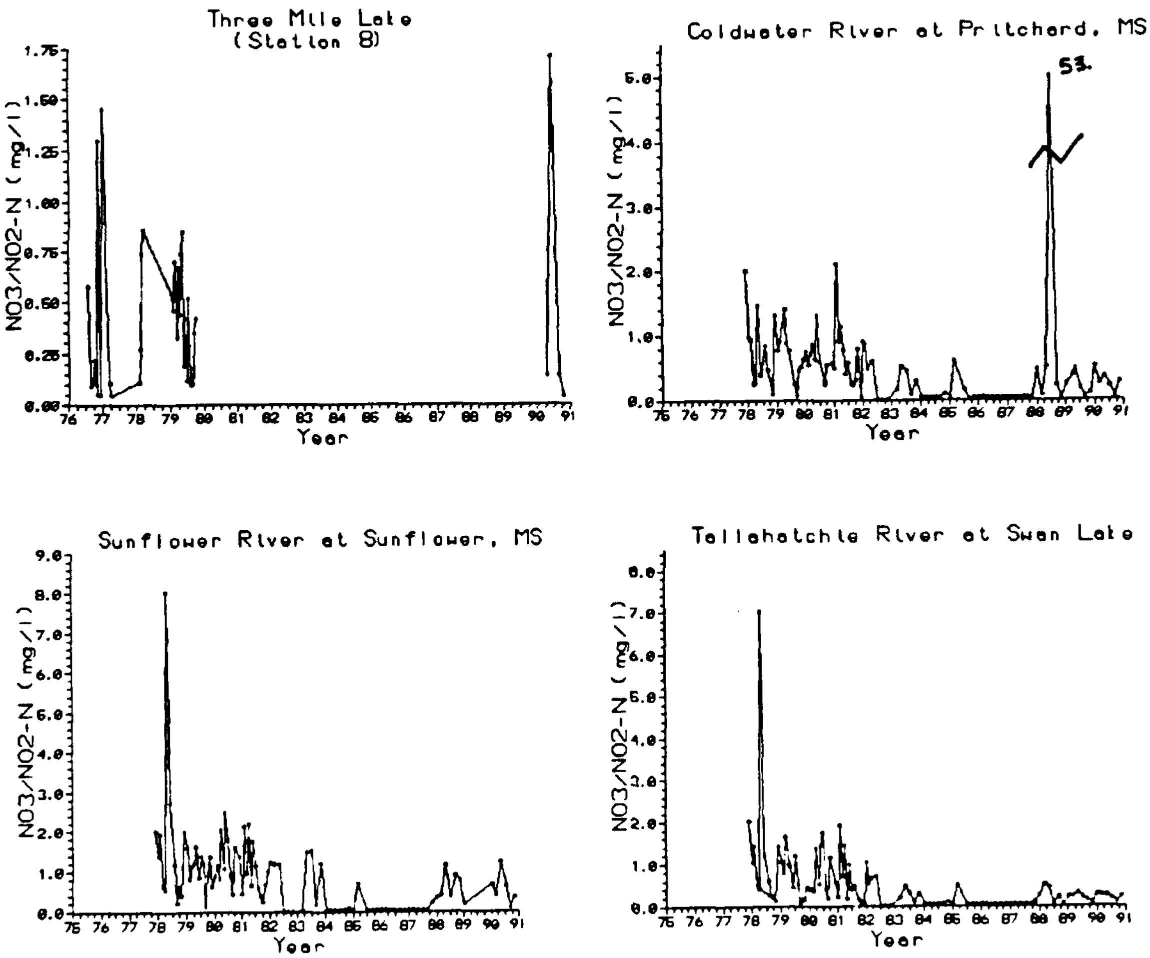


Figure VI-3. (Concluded)

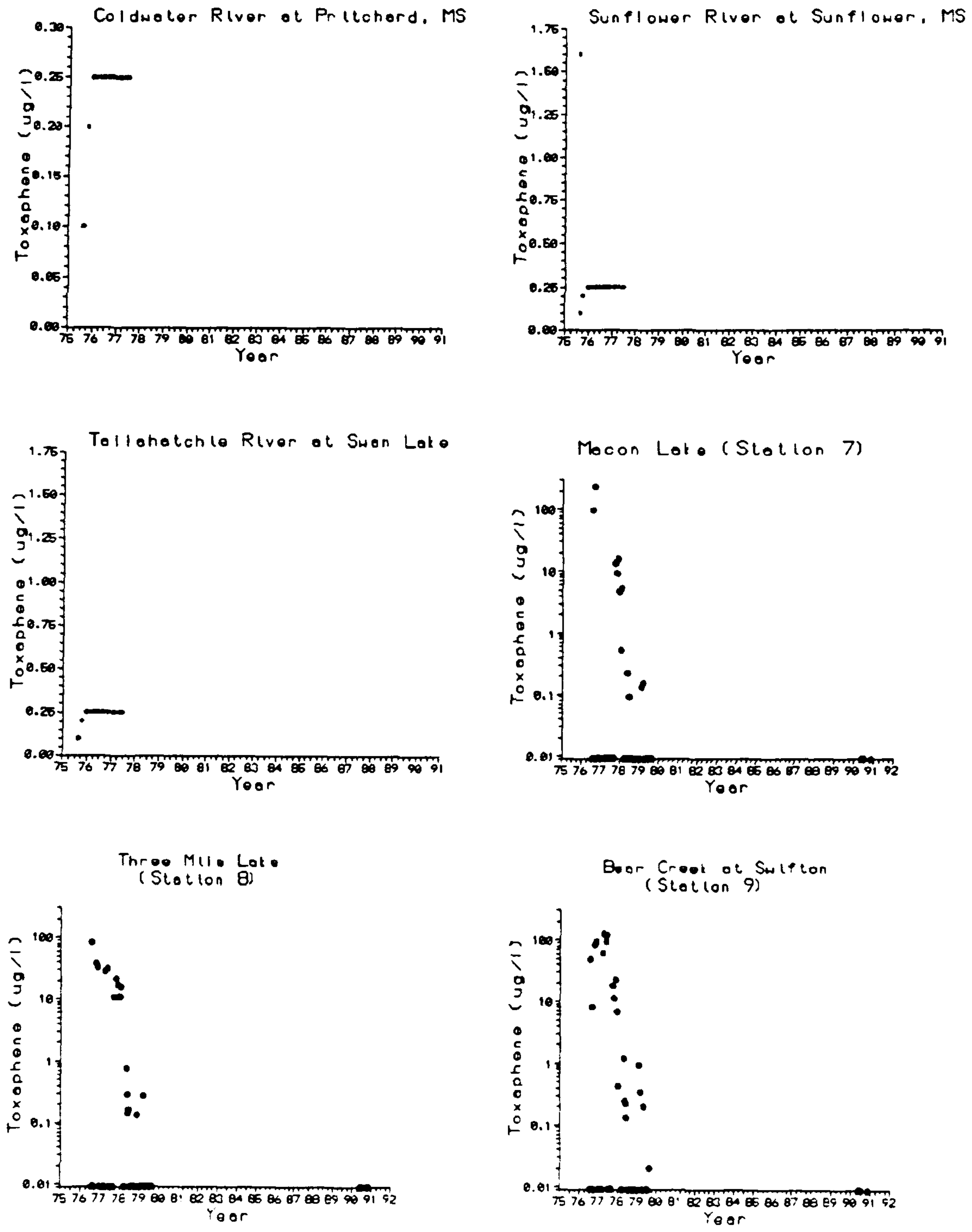


Figure VI-4. TOXAPHEN for selected UYP water bodies

PART VII: CONCLUSIONS

General water quality in the Yazoo River was consistent with the historical data, i.e., high suspended solids and high turbidity. Productivity was reduced due to lack of light penetration in spite of adequate nutrient levels in the river systems. Dissolved oxygen was consistently above water quality criteria and adequate to support fisheries. Organochlorine insecticides in the Yazoo River are much lower than in the early 1970s. Triazine and chloroacetanilide herbicides, although not measured in this study for the Yazoo River, have been reported at much lower concentrations than found in the oxbow lakes and Wasp Lake. The occurrence of lower concentrations in the river than in the lakes indicates the great dilution capacity of the Yazoo River.

General water quality in Bear Creek was no worse than in the 1970s and, for many parameters, was improved. Nutrients (e.g. ammonium, nitrate, and phosphorus) are generally lower than in the past. Pesticides in Bear Creek, especially PPDDT, HEPTCL, and TOXAPHEN, were much lower than in the 1970s. Residual pesticide levels remain in the watershed, but the frequency of detection and the concentrations were much lower than in earlier studies. New pesticides, especially the triazine and chloracetanilide herbicides, were present in the watershed with highest concentrations occurring near fields where they were applied.

Comparisons of water quality parameters in a channelized and unchannelized reach of the Yazoo River indicated no differences. The study did not distinguish between nonpoint source runoff effects and channelization effects.

Pesticide concentrations in surface sediments, sediment cores, and field soils were generally lower than in historical data. PPDDT, PPDDE, PPDDD, and HEPTCL were the most commonly detected insecticides, but concentrations were generally low. Pesticide concentrations in CDFs were usually lower than in adjacent fields. Runoff from fields continues to be a source of contamination to streams. Bioaccumulation potential for PPDDT, PPDDE, and PPDDD did not exceed FDA action levels.

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APPENDIX A: FIELD AND ANALYTICAL METHODS

APPENDIX A: FIELD AND ANALYTICAL METHODS

Field Methods

Water quality sampling

In situ measurements of temperature, dissolved oxygen, pH, and specific conductance were made at each station with a Hydrolab Surveyor (model II, Hydrolab Corporation, Austin, TX). The Hydrolab was calibrated periodically throughout the sampling period following manufacturer's guidelines (Hydrolab 1985).

Sample collection for water quality analyses was conducted with a clean bucket that was rinsed with sample water at each station prior to sample collection. Samples were collected from the surface at all stations in a manner that did not disturb bottom sediments. Sample processing was conducted onsite, and the sample was continually mixed while subsamples for various analyses were processed. Detailed sample handling is described for each parameter in the Analytical Methods section of this appendix.

Sediment samples

Surface sediment samples were collected using a Ponar sampler. Three 5-cm cores were taken from each dredge sample and composited to form one surface sediment sample. The composite was thoroughly mixed, placed in a liter glass jar, and stored on ice for transportation. Immediately upon arrival at the WES, samples were stored at 4 °C until analyzed.

Three sediment cores were collected at each designated core site. To obtain the core, a 5-cm-diam aluminum pipe was driven into the bottom sediment as far as it would go or 76 cm, whichever came first. A manual winch was used to extract the aluminum pipe containing the sediment. Comparison of actual core depths with the depth of driven pipe showed that intact cores were obtained by this method. The aluminum pipe was then cut near the sediment surface, sealed at both ends, and stored on ice for transportation. Upon arrival at WES, sediment cores were extruded from the aluminum pipes using a plunger and sectioned into appropriate intervals. For each core site, respective depth intervals from each of the three cores were composited, placed in 1-ℓ glass jars, and stored at 4 °C until analyzed. All cores were sectioned into 10-cm segments, except for the Mossy Lake core (BC 5), which was divided into six 15-cm segments, and the Cotton Project cores (YZ 15-19), which came to WES sectioned in 30-cm segments. These five sediment cores had been collected previously from the Yazoo River by the LMK for a Cotton Project. These cores (YZ 15-19) were 6 ft (180 cm) in length and were subdivided into 1-ft (30-cm) intervals in the field.

CDF and field soil samples

Seven soil samples were obtained from existing CDFs, and an equal number was taken from fields in proximity to the CDFs. Locations of the CDF sampling sites are shown in Figure IV-4. To obtain these soil samples, an aluminum tube 5 cm in diameter was driven 30 cm into the soil within the confines of the CDF. Three cores from each CDF were composited to form the sample. Samples taken from adjacent fields were composited in the same manner.

Analytical Methods - Routine Water Quality Parameters

Water temperature
Method: Thermistor thermometer.
Detection Limit: 0.1° C.
Calibration: National Bureau of Standards certified thermometer.

Dissolved oxygen
Method: Membrane electrode.
Detection limit: 0.1 mg/l.
Calibration: Air calibration.

pH (field measurement)
Method: Electrometric.
Detection Limit: 0.1 pH unit.
Calibration: Buffer solutions of ph 4 and 7.

Specific conductance (field measurement)
Method: Electrometric.
Detection limit: 1 μS/cm.
Calibration: Standard solutions of known conductivity. All readings were corrected for temperature to 25° C.

Solids
Sample preservation: Held in dark at 4° C.
A. Total solids
Method: Gravimetric.
Detection limit: 0.001g
B. Total suspended solids
Method: Gravimetric, sample filtered onto glass fiber filter.
Detection limit: 0.001g
Reference: APHA 1980.

Turbidity
Sample preservation: Held in dark at 4° C.
Method: Nephelometric.
Detection limit: 1 NTU.

Calibration: Formazin solutions of known NTU values.
Reference: HACH Corp. 1989.

<u>Carbon</u>
Sample preservation: Held in dark at 4° C.
A. Total organic carbon
Method: Carbon-Infrared.
Detection limit: 0.1mg/l.
B. Dissolved organic carbon
Method: Carbon-Infrared, filtered through a pre-combusted glass fiber filter.
Detection limit: 0.1mg/l.
Reference: APHA 1980.

<u>Nitrogen</u>
Sample preservation: Mercuric chloride/sodium chloride. Held in dark at 4° C.
A. Organic nitrogen (total NH_4 + organic nitrogen)
Method: I-4552-85, Colorimetric, block digester-salicylate-hypochlorite, automated-segmented flow.
Detection limit: 0.2 mg/l as N.
B. Nitrate/nitrite nitrogen
Method: I-2543-85, Colorimetric, hydrazine reduction-diazotization, automated-discrete, filtered through 0.4-μ filter.
Detection limit: 0.01 mg/l as N.
C. Ammonia nitrogen
Method: I-4522-85, Colorimetric, salicylate-hypochlorite, automated-segmented flow.
Detection limit: 0.01 mg/l as N.
Reference: USGS 1989.

<u>Phosphorus</u>
Sample preservation: Mercuric chloride/sodium chloride. Held in dark at 4° C.
A. Total phosphorus
Method: I-4600-85, Colorimetric, phosphomolybdate, automated-segmented flow.
Detection limit: 0.01 mg/l as P.
B. Total dissolved phosphorus
Method: I-2600-85, Colorimetric, phosphomolybdate, automated-segmented flow, filtered through a 0.4-μ filter.
Detection limit: 0.01 mg/l as P.
Reference: USGS 1989.

<u>Chlorophyll *a*</u>
Sample preservation: Held in dark at 4° C.
Method: Filtered onto a glass fiber filter, dimethyl sulfoxide (DMSO) extraction, trichromatic.
Detection Limit: 1000 mg/l.
Reference: APHA 1980

Analytical Methods - Sediments

Total organic carbon

Total organic carbon (TOC) was determined on each sediment or soil sample using Standard Method SWA 9060 (EPA 1986).

Particle size distribution

Particle size distribution was determined on each sediment or soil sample using the method of Day (1956) as modified by Patrick (1958). The particle size fractions determined were clay (<2 μm), silt (2 to 50 μm), and sand (>50 μm).

Analytical Methods - Pesticides and PCBs

Extraction methods

Water samples were extracted according to EPA Standard Method 3510 (EPA 1986). Soil and sediment samples were extracted according to EPA Standard Method 3540 (soxhlet extraction). All chlorinated insecticides, trifluralin, and PCBs were cleaned up prior to gas liquid chromatographic analysis using EPA Standard Method 3640. Currently used insecticides (phosphorus-containing insecticides) required no clean-up prior to analysis.

Gas liquid chromatographic analysis

Chlorinated insecticides, trifluralin, and PCBs were analyzed by gas liquid chromatography (GLC) according to EPA Standard Method 8080 (EPA 1986). Currently used insecticides were analyzed by GLC according to EPA Standard Method 8141. The fully automated Tracor Model 540 Dual Channel Gas Liquid Chromatograph was used with an electron capture detector and a Precision Scientific Auto Sampler (10 μl/injection).

Analytical Methods - Herbicides

Extraction

Ten grams of wet sample was spiked with 20 ml sodium hydroxide at pH 10-11, and centrifuged to separate the solid and liquid phases. The supernate was removed and cleaned with methylene chloride and salt. Ten milliliters of the cleaned supernate was acidified to pH 2 and passed through a C18 solid phase extraction cartridge. Herbicides were eluted with 1 ml of HPLC grade acetonitrile.

Analysis

Herbicides were analyzed by high performance liquid chromatography (HPLC). The chromatograph (Waters Associate) contained a photodiode array detector, 600E fluid handling system, WISP autosampler and microprocessor. A modification of the method of Di Corcia et al. (1989) with a reversed-phase C18 column (Waters Novapack 3.9 X 150 mm) was used. The mobile phase was premixed to contain 99.92 percent water and methanol (45:55 percent v/v) and 0.08 percent (v/v) trifluoroacetic acid. The flow rate was 0.8 ml per minute. The herbicides were monitored with the detector set at 228 nm for measuring peak area and at 230 nm for measuring peak height. Sample integration used six multicomponent calibration standards. The need to use wet sediment for extraction prior to analysis resulted in detection limits that varied from 0.1 to 0.23 mg/kg, depending upon the solids content of the wet sediment.

Table A1

Detection Limits of Organic Contaminants

Parameter	Detection Limits: Water (mg/l)	Detection Limits: Soil/Sediment (mg/kg)
Chlorinated Insecticides	<0.00001	<0.0002
Currently Used Insecticides	<0.00001	<0.0020
Herbicides*	<0.0008	<0.100 - 0.230
PCBs	ND**	<0.0020

* Except TRIFLURA which has detection limits of <0.00001 mg/l in water.
** Water samples were not analyzed for PCBs.

APPENDIX B: BEAR CREEK DATA

Table B1

Bear Creek Water Quality - Field Data

Station	Date	Temp (°C)	DO (mg/l)	pH	Cond (umhos/cm)	Turb (ntu)	Barometer (mm of Hg)
1	4-18-90	17.5	4.6	7.05	68	27	767
	6-07-90	29.0	12.0	7.76	76	6	760
	8-29-90	32.0	7.5	6.75	102	8	755
	10-11-90	19.5	2.8	6.44	96	30	760
2	4-18-90	14.5	3.3	7.05	72	25	767
	6-07-90	28.0	3.3	6.7	81	10	760
	8-29-90	27.0	1.0	7.2	92	12	755
	10-11-90	13.0	1.8	6.5	99	18	760
3	4-18-90	14.0	5.2	7.1	65	27	765
	6-07-90	28.0	5.2	6.5	76	11	760
4	4-18-90	15.0	5.3	7.3	63	55	765
	6-07-90	29.0	6.0	7.0	75	45	760
	8-29-90	28.5	2.5	7.2	345	6	757
	10-11-90	14.5	3.4	7.04	228	15	760
5	4-17-90	16.5	8.4	7.1	63	140	760
5a	4-18-90	13.0	4.2	7.3	88	150	765
	6-07-90	30.0	6.3	6.8	81	110	760
	8-29-90	30.0	3.0	7.45	360	10	757
	10-10-90	18.0	4.6	6.78	282	35	760
6	4-17-90	16.5	6.7	7.4	50	85	760
	6-07-90	27.0	6.2	6.75	76	95	760
	8-29-90	32.0	5.9	7.2	179	5	757
	10-10-90	20.4	7.2	6.64	193	20	760
7	4-17-90	18.0	8.5	7.5	43	45	760
	6-07-90	29.0	8.1	7.0	50	23	760
	8-29-90	31.5	8.9	7.6	51	7	757
	10-10-90	21.5	6.5	6.52	44	35	760
8	4-17-90	17.5	5.3	7.1	80	75	760
	6-07-90	27.0	5.2	6.16	74	175	760
	8-29-90	31.0	3.6	7.45	323	8	757
	10-10-90	17.5	6.4	6.94	242	32	760
9	4-17-90	17.0	5.0	6.95	66	65	760
	6-07-90	27.0	6.6	6.45	74	90	760
	8-29-90	31.0	5.2	7.35	149	25	757
	10-10-90	18.5	7.2	6.52	157	38	760
10	4-17-90	17.5	6.3	7.05	80	100	760
	6-07-90	26.0	5.4	6.3	85	85	760
	8-29-90	31.0	5.5	6.46	108	25	757
	10-10-90	20.5	4.7	7.15	111	50	760
11	4-17-90	20.0	7.9	7.0	70	105	760
	6-07-90	28.5	8.3	6.05	78	130	760
	8-29-90	31.5	6.7	7.40	99	18	757
	10-10-90	20.6	7.4	6.48	90	70	760

Table B2

Bear Creek Water Quality - Field Data with Depth

Station	Date	Time	Depth (ft)	pH	Cond (μmhos/cm)	Temp (°C)	DO (mg/l)
1	4-18-90	12:31	1.0	7.0	68	17.5	4.6
		12:32	15.0	6.9	90	15.0	2.0
		12:33	20.0	6.9	115	14.5	0.4
	6-07-90	18:01	1.0	7.8	76	29.0	12.0
		18:02	16.0	6.8	181	19.0	0.4
	8-29-90	15:46	1.0	6.8	102	32.0	7.5
		15:47	5.0	6.7	115	31.0	6.0
		15:48	12.0	6.6	186	27.0	0.0
	10-11-90	9:31	1.0	6.4	96	19.5	2.8
		9:32	12.0	6.3	96	20.5	1.8
6	6-07-90	13:46	1.0	6.8	76	27.0	6.2
		13:47	10.0	6.6	93	24.5	1.7
	8-29-90	13:31	1.0	7.2	179	32.0	5.9
		13:32	7.0	7.2	205	29.5	0.1
	10-10-90	15:46	1.0	6.6	193	20.5	7.2
		15:47	7.0	6.8	193	20.5	6.5
7	6-07-90	12:31	1.0	7.0	50	29.0	8.1
		12:32	9.0	6.2	60	23.5	0.3
	8-29-90	12:01	1.0	7.6	51	31.5	8.9
		12:02	5.0	7.6	51	31.0	5.4
	10-10-90	17:31	1.0	6.5	44	21.5	6.5
		17:32	7.0	6.4	43	21.0	5.8
8	6-07-90	13:01	1.0	6.2	74	27.0	5.2
		13:02	3.0	6.2	74	27.0	5.2
9	6-07-90	11:31	1.0	6.4	74	27.0	6.6
		11:32	5.0	6.4	75	26.0	4.1
10	6-07-90	11:01	1.0	6.3	85	26.0	5.4
		11:02	7.0	6.2	87	24.5	0.9
	8-29-90	11:01	1.0	7.2	111	31.0	4.7
		11:02	3.0	7.1	111	31.0	3.3
	10-10-90	12:31	1.0	6.5	108	20.5	5.5
		12:32	3.0	6.5	108	20.5	4.6
11	4-17-90	11:31	1.0	7.0	70	20.0	7.9
		11:32	10.0	7.0	74	16.5	4.7
	6-07-90	9:31	1.0	6.1	78	28.5	8.3
		9:32	7.0	6.1	80	24.0	0.5
	8-29-90	10:01	1.0	7.4	99	31.5	6.7
		10:02	5.0	7.0	105	31.0	0.9
	10-10-90	11:46	1.0	6.5	90	20.5	7.4
		11:47	5.0	6.5	90	21.5	6.5

Table B3

Bear Creek Water Quality - Laboratory Analyses

Station	Date	TS (mg/l)	TSS (mg/l)	Chla (ug/l)	TOC (mg/l)	DOC (mg/l)	ON (mg/l)	NO2/NO3-N (mg/l)	NH3-N (mg/l)	TP (mg/l)	TDP (mg/l)
1	4-18-90	90	13	4.28	5.7	5.7	0.65	0.13	0.10	0.44	0.210
	6-07-90	75	14	6.62	5.4	5.3	0.77	0.22	<0.01	0.15	0.080
	8-29-90	90	<4	3.34	5.9	5.9	0.99	0.15	0.01	0.07	0.030
	10-11-90	126	54	5.85	7.6	7.6	1.06	.nr	0.24	0.13	0.050
2	4-18-90	104	6	2.14	6.0	6.1	0.57	0.11	0.16	0.70	0.270
	6-07-90	85	18	5.82	5.4	5.2	0.90	0.20	0.04	0.22	0.140
	8-29-90	96	12	6.01	6.8	6.4	1.30	0.21	0.10	0.30	0.120
	10-11-90	110	40	0.00	9.0	9.0	1.19	0.04	0.11	0.28	0.090
3	4-18-90	109	31	10.40	6.1	6.0	0.76	0.12	0.12	0.40	0.180
	6-07-90	88	23	5.71	5.6	5.5	0.99	0.06	0.01	0.25	0.110
4	4-18-90	154	50	7.74	5.9	5.9	0.88	0.09	0.04	0.35	0.070
	6-07-90	145	87	9.76	5.7	5.5	1.06	0.45	0.04	0.42	0.100
	8-29-90	255	24	8.02	4.1	3.8	1.08	0.24	0.02	0.16	0.060
	10-11-90	170	30	3.68	5.8	5.8	0.75	0.05	0.08	0.16	0.090
5	4-17-90	380	267	13.37	5.2	5.5	1.42	0.09	0.08	0.64	0.020
5a	4-18-90	334	252	6.24	5.3	5.6	1.00	0.26	0.20	0.58	0.040
	6-07-90	272	181	9.80	5.1	4.8	1.48	1.10	0.12	0.43	0.080
	8-29-90	247	10	1.34	4.5	4.2	2.21	0.21	0.09	0.14	0.080
	10-10-90	257	74	5.88	6.4	6.4	1.28	0.13	0.12	0.15	0.060
6	4-17-90	179	62	3.77	4.5	4.9	0.60	0.17	0.08	0.24	0.040
	6-07-90	193	50	2.09	4.4	4.2	0.70	0.56	0.12	0.22	0.130
	8-29-90	128	<4	3.34	4.5	3.9	0.62	0.19	0.01	0.07	0.030
	10-10-90	173	52	5.35	5.0	5.0	0.93	0.05	0.01	0.08	0.050
7	4-17-90	122	24	9.36	4.3	4.5	0.74	0.07	0.04	0.17	0.020
	6-07-90	82	14	4.11	4.5	4.3	0.64	0.18	0.01	0.11	0.080
	8-29-90	55	<4	6.01	4.5	4.1	1.09	0.20	0.01	0.07	0.030
	10-10-90	99	56	5.88	4.7	4.7	1.05	0.02	0.05	0.10	0.050
8	4-17-90	200	110	8.55	6.1	6.2	1.02	0.14	0.08	0.34	0.050
	6-07-90	318	223	3.21	4.7	4.5	0.33	1.70	0.17	0.44	0.060
	8-29-90	238	32	4.68	5.0	4.4	1.09	0.14	0.01	0.17	0.060
	10-10-90	207	66	2.14	5.8	5.8	1.05	0.04	0.05	0.13	0.060
9	4-17-90	167	38	2.81	5.3	5.6	0.75	0.17	0.10	0.30	0.050
	6-07-90	185	63	4.76	4.8	4.5	1.65	0.60	0.05	0.27	0.080
	8-29-90	159	34	9.36	5.2	4.8	1.48	0.22	0.02	0.21	0.070
	10-10-90	175	74	4.81	5.5	5.5	1.08	0.05	0.02	0.15	0.050
10	4-17-90	216	30	3.21	5.0	5.1	0.85	0.36	0.08	0.35	0.050
	6-07-90	226	51	12.30	4.8	4.5	1.47	0.91	0.03	0.29	0.050
	8-29-90	121	20	6.01	4.9	4.6	1.08	0.15	0.02	0.12	0.060
	10-10-90	147	70	5.88	4.9	4.9	1.04	0.03	0.06	0.13	0.050
11	4-17-90	209	57	4.46	5.1	5.3	0.76	0.22	0.04	0.32	0.060
	5-07-90	212	63	7.21	4.1	4.0	1.57	0.90	0.03	0.21	0.040
	8-29-90	107	22	20.05	5.1	5.1	2.08	0.12	0.02	0.14	0.040
	10-10-90	180	102	12.25	5.0	5.0	1.24	0.05	0.06	0.14	0.050

nr - Data not received yet

Table B4

Chlorinated Insecticides - Bear Creek, April 18, 1990

Station	River Mile	ALDRIN (mg/l)	A-BHC (mg/l)	B-BHC (mg/l)	G-BHC (mg/l)	D-BHC (mg/l)	PPDDD (mg/l)	PPDDE (mg/l)	PPDDT (mg/l)	HPTCL (mg/l)	DIELDRIN (mg/l)	ENDOI (mg/l)	ENDOII (mg/l)	ENDOSU (mg/l)	ENDRIN (mg/l)
1	49.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	0.00001	<0.00001
2	48.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00003	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
3	46.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
4	44.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
5A	36.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	0.00002	0.00002	0.00001	<0.00001	<0.00001	0.00001	<0.00001
6	30.6	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00004	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
7	28.8	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
8	24.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
9	18.0	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
10	13.4	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
M BLANK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00002

Station	ENDALD (mg/l)	HPTCLE (mg/l)	METOXYCL (mg/l)	CLORDANE (mg/l)	TOXAPHEN (mg/l)
1	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
2	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
3	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
4	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
5A	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
6	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
7	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
8	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
9	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
10	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
11	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
M BLANK	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002

Table B5

Chlorinated Insecticides - Bear Creek, June 7, 1990

Station	River Mile	ALDRIN (mg/l)	A-BHC (mg/l)	B-BHC (mg/l)	G-BHC (mg/l)	D-BHC (mg/l)	PPDDD (mg/l)	PPDDE (mg/l)	PPDDT (mg/l)	HPTCL (mg/l)	DIELDRIN (mg/l)	ENDOI (mg/l)	ENDOII (mg/l)	ENDOSU (mg/l)	ENDRIN (mg/l)
1	49.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
2	48.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001**	<0.00001
3	46.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001**	<0.00001
4	44.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
5A	36.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00002**	<0.00001
6	30.6	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
7	28.8	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
8	24.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00002**	<0.00001
9	18.0	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001**	<0.00001
10	13.4	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
M BLANK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Station	ENDALD (mg/l)	HPTCLE (mg/l)	METOXYCL (mg/l)	CLORDANE (mg/l)	TOXAPHEN (mg/l)
1	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
2	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
3	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
4	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
5A	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
6	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
7	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
8	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
9	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
10	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
11	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
M BLANK	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002

Table B6

Chlorinated Insecticides - Bear Creek, August 29, 1990

Station	River Mile	ALDRIN (mg/l)	A-BHC (mg/l)	B-BHC (mg/l)	G-BHC (mg/l)	D-BHC (mg/l)	PPDDD (mg/l)	PPDDE (mg/l)	PPDDT (mg/l)	HPTCL (mg/l)	DIELDRIN (mg/l)	ENDOI (mg/l)	ENDOII (mg/l)	ENDOSU (mg/l)	ENDRIN (mg/l)
1	49.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00008**	<0.00001	<0.00001	<0.00001	**0.00002**	<0.00001
4	44.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00005**	<0.00001	<0.00001	<0.00001	**0.00004**	<0.00001
8	24.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001**	**0.00001**	<0.00001	<0.00001	**0.00002**	<0.00001
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
M BLANK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00003**	<0.00001	<0.00001	<0.00001	**0.00002**

Station	ENDALD (mg/l)	HPTCLE (mg/l)	METOXYCL (mg/l)	CLORDANE (mg/l)	TOXAPHEN (mg/l)
1	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
4	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
8	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
11	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
M BLANK	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002

Table B7

Chlorinated Insecticides - Bear Creek, October 10, 1990

Station	River Mile	ALDRIN (mg/L)	A-BHC (mg/L)	B-BHC (mg/L)	G-BHC (mg/L)	D-BHC (mg/L)	PPDDD (mg/L)	PPDDE (mg/L)	PPDDT (mg/L)	HPTCL (mg/L)	DIELDRIN (mg/L)	ENDOI (mg/L)	ENDOII (mg/L)	ENDOSU (mg/L)	ENDRIN (mg/L)
1	49.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
2	48.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
3	46.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
4	44.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
5A	36.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
6	30.6	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
7	28.8	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00001**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
8	24.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
9	18.0	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
10	13.4	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
M BLANK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00003**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Station	ENDALD (mg/L)	HPTCLE (mg/L)	METOXYCL (mg/L)	CLORDANE (mg/L)	TOXAPHEN (mg/L)
1	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
2	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
3	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
4	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
5A	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
6	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
7	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
8	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
9	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
10	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
11	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
M BLANK	**0.00002**	<0.00001	**0.00016**	<0.0002	<0.0002

Table B8

Currently Used Insecticides - Bear Creek, April 19, 1990

Station	River Mile	DIAZINON (mg/l)	ETPATH (mg/l)	ETTRITH (mg/l)	ETHION (mg/l)	MALATH (mg/l)	METPATH (mg/l)	CHLPYFOS (mg/l)	DICRPHOS (mg/l)	AZODRIN (mg/l)	METHYOML (mg/l)	AZPHMETH (mg/l)	SULPROFO (mg/l)	METAMIPH (mg/l)
1	49.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
2	48.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
3	46.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
4	44.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
5A	36.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
6	30.6	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
7	28.8	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
8	24.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
9	18	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
10	13.4	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
M BLANK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Table B9

Currently Used Insecticides - Bear Creek, June 7, 1990

Station	River Mile	DIAZINON (mg/l)	ETPATH (mg/l)	ETTRITH (mg/l)	ETHION (mg/l)	MALATH (mg/l)	METPATH (mg/l)	CHLPYFOS (mg/l)	DICRPHOS (mg/l)	AZODRIN (mg/l)	METHYOML (mg/l)	AZPHMETH (mg/l)	SULPROFO (mg/l)	METAMIPH (mg/l)
1	49.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
2	48.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
3	46.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
4	44.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
5A	36.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
6	30.6	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
7	28.8	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
8	24.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
9	18	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
10	13.4	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
M BLANK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Table B10

Currently Used Insecticides - Bear Creek, August 29, 1990

Station	River Mile	DIAZINON (mg/l)	ETPATH (mg/l)	ETTRITH (mg/l)	ETHION (mg/l)	MALATH (mg/l)	METPATH (mg/l)	CHLPYFOS (mg/l)	DICRPHOS (mg/l)	AZODRIN (mg/l)	METHYOML (mg/l)	AZPHMETH (mg/l)	SULPROFO (mg/l)	METAMIPH (mg/l)
1	49.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
4	44.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
8	24.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
M BLANK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Table B11

Currently Used Insecticides - Bear Creek, October 11, 1990

Station	River Mile	DIAZINON (mg/l)	ETPATH (mg/l)	ETTRITH (mg/l)	ETHION (mg/l)	MALATH (mg/l)	METPATH (mg/l)	CHLPYFOS (mg/l)	DICRPHOS (mg/l)	AZODRIN (mg/l)	METHYOML (mg/l)	AZPHMETH (mg/l)	SULPROFO (mg/l)	METAMIPH (mg/l)
1	49.9	<0.00001	<0.00001	0.0006	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
2	48.2	<0.00001	<0.00001	0.0098	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
3	46.7	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
4	44.2	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
5A	36.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
6	30.6	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
7	28.8	<0.00001	<0.00001	0.0006	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
8	24.9	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
9	18	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
10	13.4	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
11	2.3	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
M BLANK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Table B12

Herbicides - Bear Creek, April 19, 1990

Station	River Mile	TRIFLURA (mg/l)	2,4-D (mg/l)	2,4-DP (mg/l)	2,4,5-T (mg/l)	2,4,5-TP (mg/l)	2,4-DB (mg/l)
1	49.9	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
2	48.2	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
3	46.7	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
4	44.2	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
5A	36.9	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
6	30.6	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
7	28.8	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
8	24.9	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
9	18	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
10	13.4	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
11	2.3	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008

Table B13

Herbicides - Bear Creek, June 7, 1990

Station	River Mile	TRIFLURA (mg/l)	2,4-D (mg/l)	2,4-DP (mg/l)	2,4,5-T (mg/l)	2,4,5-TP (mg/l)	2,4-DB (mg/l)
1	49.9	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
2	48.2	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
3	46.7	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
4	44.2	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
5A	36.9	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
6	30.6	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
7	28.8	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
8	24.9	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
9	18	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
10	13.4	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
11	2.3	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008

Table B14

Herbicides - Bear Creek, August 29, 1990

Station	River Mile	TRIFLURA (mg/l)	2,4-D (mg/l)	2,4-DP (mg/l)	2,4,5-T (mg/l)	2,4,5-TP (mg/l)	2,4-DB (mg/l)
1	49.9	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
4	44.2	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
8	24.9	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
11	2.3	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008

Table B15

Herbicides - Bear Creek, October 11, 1990

Station	River Mile	TRIFLURA (mg/l)	2,4-D (mg/l)	2,4-DP (mg/l)	2,4,5-T (mg/l)	2,4,5-TP (mg/l)	2,4-DB (mg/l)
1	49.9	<0.00005	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
2	48.2	<0.00005	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
3	46.7	<0.00005	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
4	44.2	<0.00005	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
5A	36.9	<0.00005	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
6	30.6	<0.00005	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
7	28.8	<0.00005	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
8	24.9	<0.00005	<0.0008	<0.0008	**0.0001J**	<0.0008	<0.0008
9	18	<0.00005	<0.0008	<0.0008	**0.0001J**	<0.0008	<0.0008
10	13.4	<0.00005	<0.0008	<0.0008	**0.0012**	<0.0008	<0.0008
11	2.3	<0.00005	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008

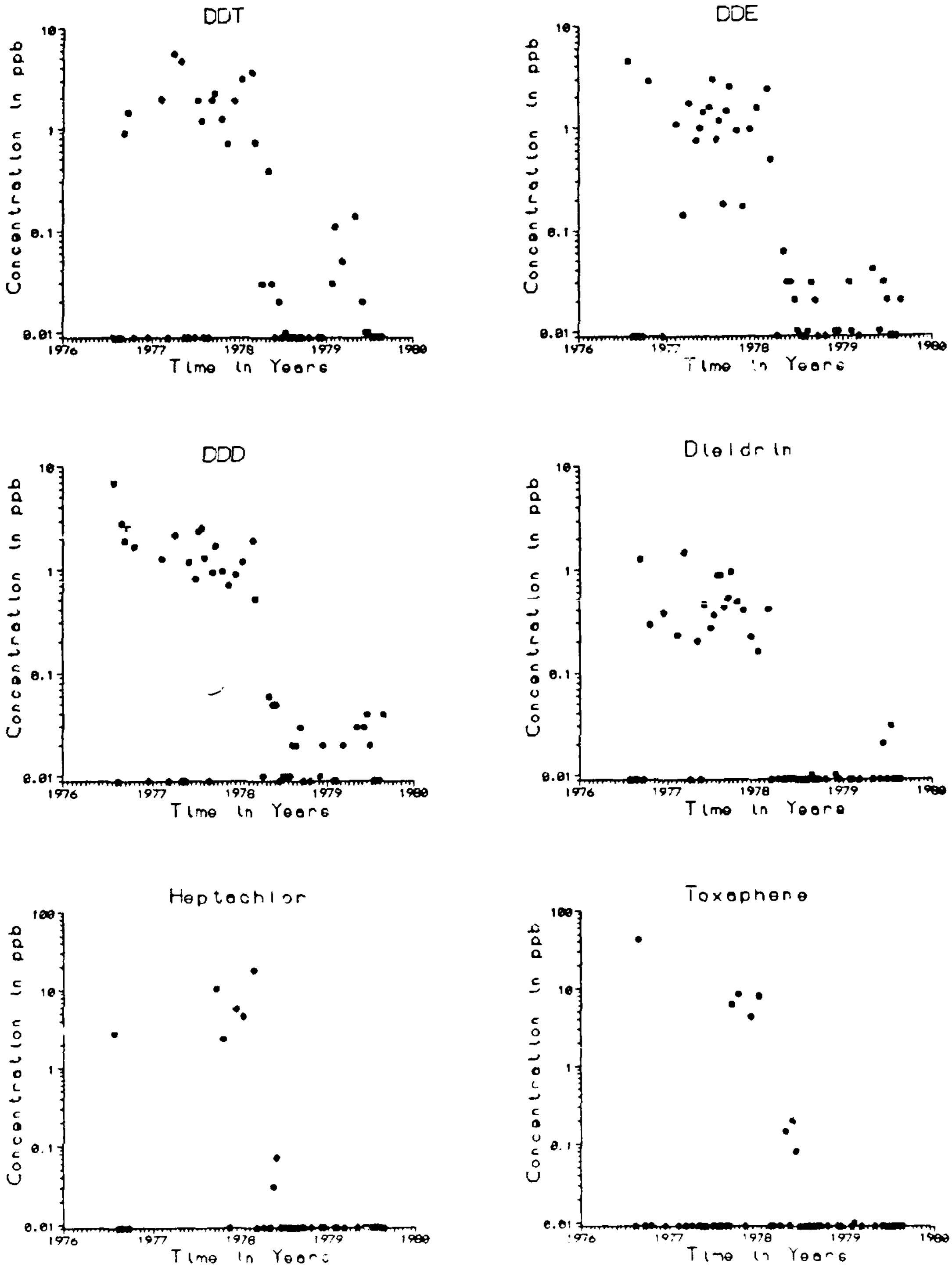

Figure B1. Temporal distribution of pesticides in Bear Creek, Blue Lake (Station 1), 1976-79 (USDA 1976 to 1979).

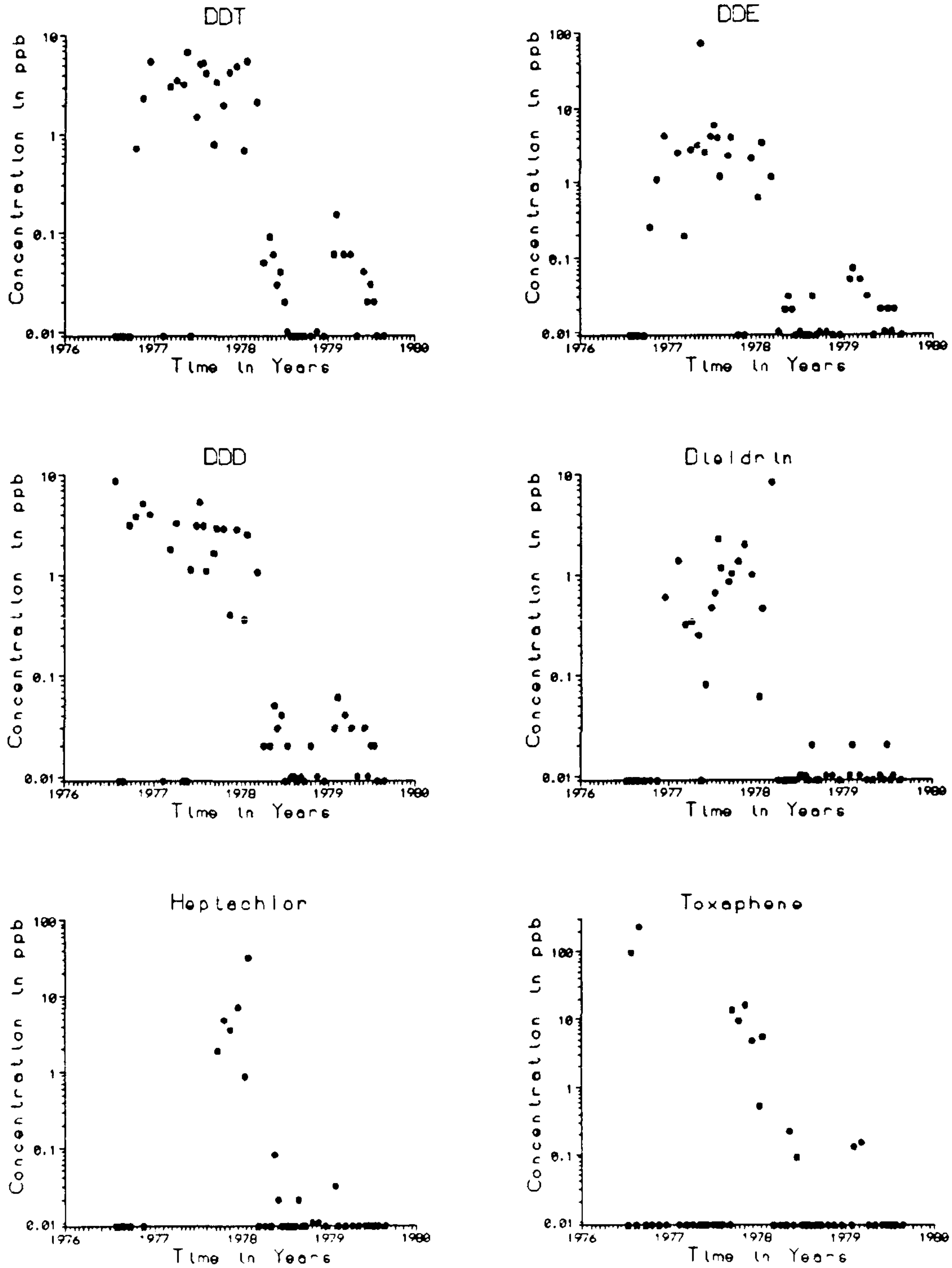

Figure B2. Temporal distribution of pesticides in Bear Creek, Macon Lake (Station 7), 1976-1979 (USDA 1976 to 1979).

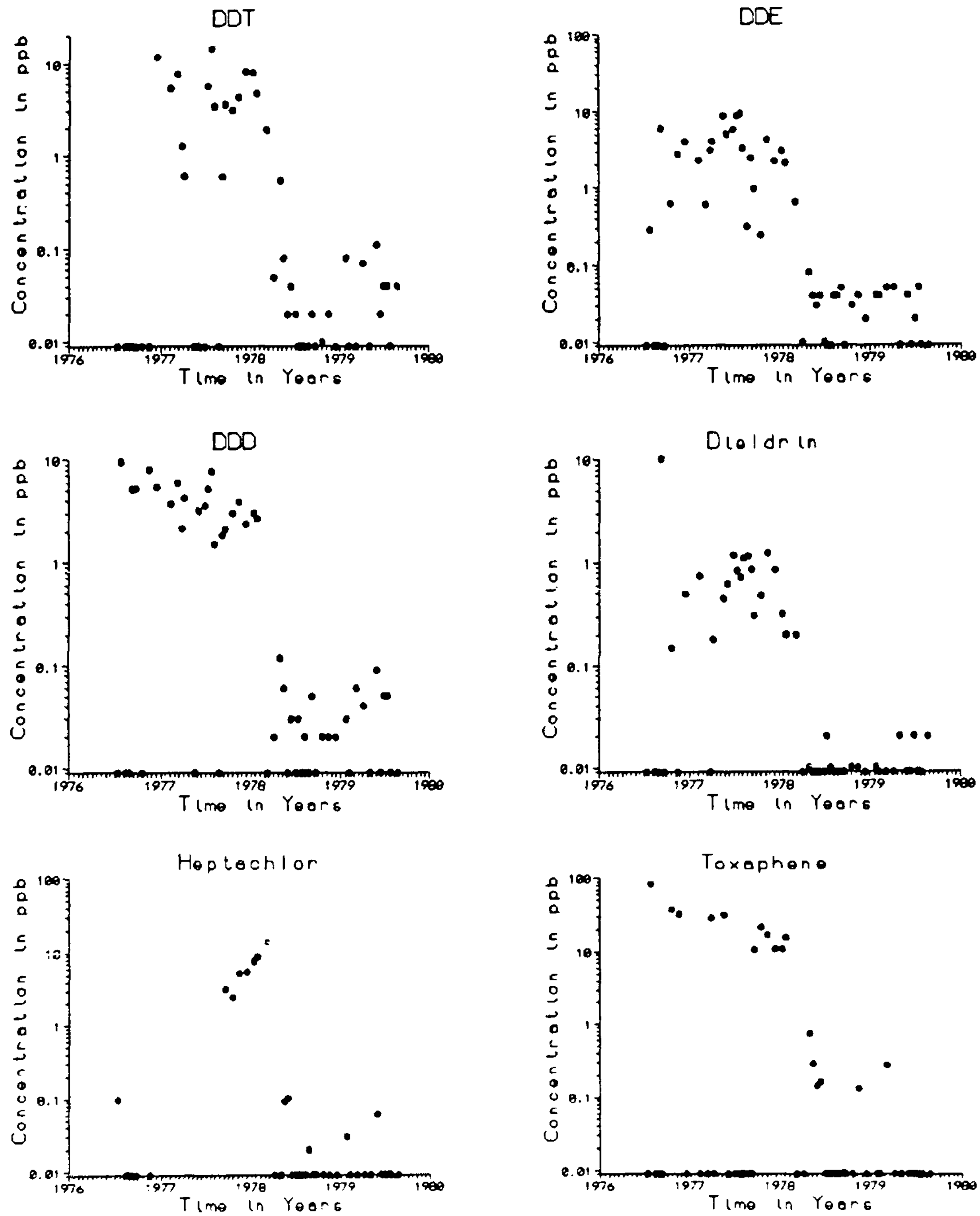

Figure B3. Temporal distribution of pesticides in Bear Creek, Three Mile Lake (Station 8), 1976-1979 (USDA 1976 to 1979).

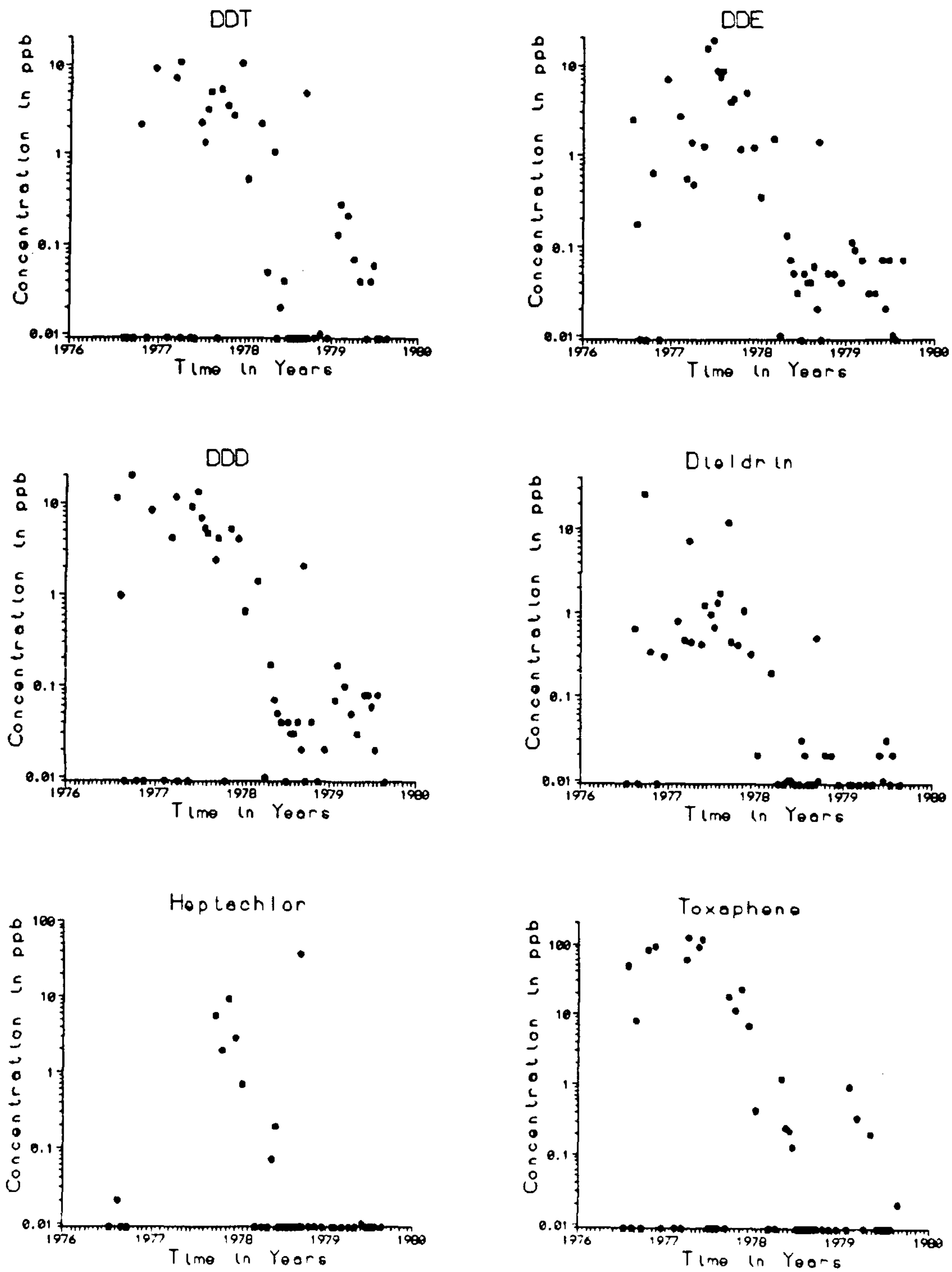

Figure B4. Temporal distribution of pesticides in Bear Creek near Swiftown (Station 9), 1976-1979 (USDA 1976 to 1979).

APPENDIX C: YAZOO RIVER DATA

Table C1

Chlorinated Insecticides - Yazoo River, April 18, 1990

Station	River Mile	ALDRIN (mg/L)	A-BHC (mg/L)	B-BHC (mg/L)	G-BHC (mg/L)	D-BHC (mg/L)	PPDDD (mg/L)	PPDDE (mg/L)	PPDDT (mg/L)	HPTCL (mg/L)	DIELDRIN (mg/L)	ENDOI (mg/L)	ENDOII (mg/L)	ENDOSU (mg/L)	ENDRIN (mg/L)
1	117	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
2	132	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
3	150	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
MTHD BLK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00002**

Station	ENDALD (mg/L)	HPTCLE (mg/L)	METOXYCL (mg/L)	CLORDANE (mg/L)	TOXAPHEN (mg/L)
1	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
2	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
3	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
M BLANK	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002

TABLE C2

Chlorinated Insecticides - Yazoo River, October 11, 1990

Station	River Mile	ALDRIN (mg/L)	A-BHC (mg/L)	B-BHC (mg/L)	G-BHC (mg/L)	D-BHC (mg/L)	PPDDD (mg/L)	PPDDE (mg/L)	PPDDT (mg/L)	HPTCL (mg/L)	DIELDRIN (mg/L)	ENDOI (mg/L)	ENDOII (mg/L)	ENDOSU (mg/L)	ENDRIN (mg/L)
1	117	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00004**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
2	132	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
3	150	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
MTHD BLK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00003**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Station	ENDALD (mg/L)	HPTCLE (mg/L)	METOXYCL (mg/L)	CLORDANE (mg/L)	TOXAPHEN (mg/L)
1	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
2	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
3	<0.00001	<0.00001	<0.00001	<0.0002	<0.0002
MTHD BLK	**0.00002**	<0.00001	**0.00016**	<0.0002	<0.0002

Table C3

Currently Used Insecticides - Yazoo River, April 19, 1990

Station	River Mile	DIAZINON (mg/l)	ETPATH (mg/l)	ETTRITH (mg/l)	ETHION (mg/l)	MALATH (mg/l)	METPATH (mg/l)	CHLPYFOS (mg/l)	DICRPHOS (mg/l)	AZODRIN (mg/l)	METHYOML (mg/l)	AZPHMETH (mg/l)	SULPROFO (mg/l)	METAMIPH (mg/l)
1	117	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
2	132	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
3	150	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
MTHD BLK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Table C4

Currently Used Insecticides - Yazoo River, October 11, 1990

Station	River Mile	DIAZINON (mg/l)	ETPATH (mg/l)	ETTRITH (mg/l)	ETHION (mg/l)	MALATH (mg/l)	METPATH (mg/l)	CHLPYFOS (mg/l)	DICRPHOS (mg/l)	AZODRIN (mg/l)	METHYOML (mg/l)	AZPHMETH (mg/l)	SULPROFO (mg/l)	METAMIPH (mg/l)
1	117	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
2	132	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
3	150	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
MTHD BLK		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Table C5

HERBICIDES - Yazoo River, April 18, 1990

Station	River Mile	TRIFLURA (mg/l)	2,4-D (mg/l)	2,4-DP (mg/l)	2,4,5-T (mg/l)	2,4,5-TP (mg/l)	2,4-DB (mg/l)
1	117	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
2	132	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
3	150	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
MTHD BLK		<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008

Table C6

HERBICIDES - Yazoo River, October 11, 1990

Station	River Mile	TRIFLURA (mg/l)	2,4-D (mg/l)	2,4-DP (mg/l)	2,4,5-T (mg/l)	2,4,5-TP (mg/l)	2,4-DB (mg/l)
1	117	<0.00001	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
2	132	<0.00001	<0.0008	<0.0008	<0.0011	<0.0008	<0.0008
3	150	<0.00001	<0.0008	<0.0008	<0.0002J	<0.0008	<0.0008
MTHD BLK		<0.00005	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008